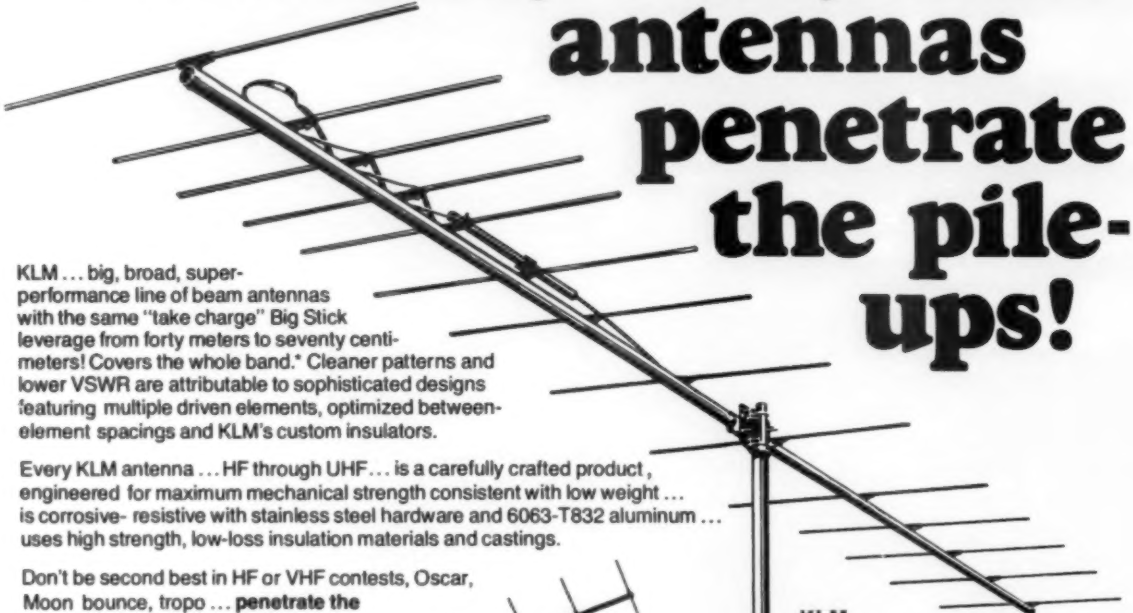
JANUARY 1977
$2.00

73 AMATEUR RADIO

REPEATER
NORMAL
OFF
REV.
DRIVE
0
500
1000
FINAL
146
144
148
RIT
0
-
+
SQUELCH
CAL ON
AF GAIN
RF GAIN
BAND
146
FIX. CH
VFO

KLM HF, VHF, UHF antennas penetrate the pile-ups!

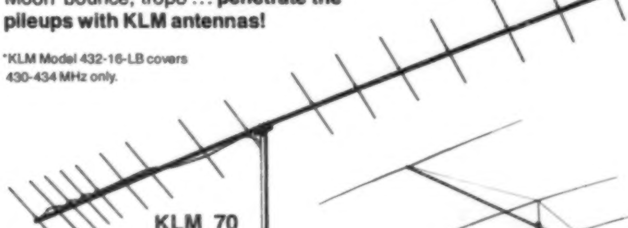


KLM ... big, broad, super-performance line of beam antennas with the same "take charge" Big Stick leverage from forty meters to seventy centimeters! Covers the whole band.* Cleaner patterns and lower VSWR are attributable to sophisticated designs featuring multiple driven elements, optimized between-element spacings and KLM's custom insulators.

Every KLM antenna ... HF through UHF ... is a carefully crafted product, engineered for maximum mechanical strength consistent with low weight ... is corrosive- resistive with stainless steel hardware and 6063-T832 aluminum ... uses high strength, low-loss insulation materials and castings.

Don't be second best in HF or VHF contests, Oscar, Moon bounce, tropo ... **penetrate the pileups with KLM antennas!**

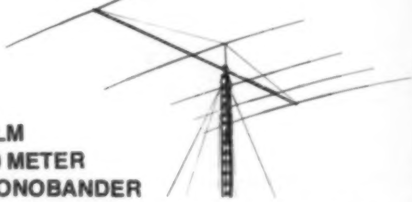
*KLM Model 432-16-LB covers 430-434 MHz only.



KLM 70 CENTIMETER ANTENNAS

The fine series of UHF antennas consists of 6,14 and 27 element high gain, broad coverage antennas (6 and 14 element types are rear mountable). **All antennas** (except the 432-16-LB) **cover 420-450 MHz without need for tuning.** These are ideal, maximum gain antennas for point-to-point or repeater control applications. An available **long boom** 12' model), optimized at 432 ± 2MHz, is particularly desirable for EME and DX communications. Eight of these beams, using KLM high efficiency couplers are comparable to a 128 element, extended, expanded collinear array.

A typical antenna: (KLM-420-470-14)
Elements: 14.
Gain: 11.5db (dipole reference)
Beam width: 18 degrees @ 3db pts.
Diameters: Boom: 1" (25.4mm).
Elements ⅜"D (9.5mm)



KLM 20 METER MONOBANDER

Do you operate both phone and CW and so are forced to compromise with higher VSWR on one or the other mode? **Not with this KLM 20 meter monobander!** Multiple driven elements and other KLM design exclusives, give broad-band action, low VSWR over 13.9 to 14.4MHz. F/B (and sides) ratio is excellent, gain is exceptionally high. (9.75 dipole reference). Impedance is 200 ohms balanced (matched w/KLM's 4:1 4KW p.e.p. balun (optionally available). Assembly is simple and fast.

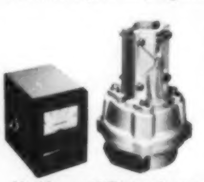
Other KLM beams for 40,15 and 10 meters feature dual driven elements for high gain, F/B ratio and low VSWR over both phone and CW band sections. **Also, a 7 element log periodic** w/26' turning radius, 30' boom (3", 76 mm) D **that gives continuous coverage, 10-30MHz!** Makes an excellent **NO TRAP**, 20-15-10 meter beam with gains equivalent to long boom, 3 element Yagi. Matches 50 ohm line w/4KW p.e.p. balun (supplied).

5 full size elements: Boom: 42', 3" (76mm)D.
Turning radius: 28' **Wgt:** 65 lbs. (29.4KG)

KLM 2 METER ANTENNAS

The antennas in this series will beat all comers! Individually, these antennas are doing a tremendous job where high gain, F/B ratio and low VSWR are important ... in VHF DX contests for example. Many are stacking them for moon bounce and tropo work using available KLM baluns and couplers. Included in the series are antennas with 7, 8, 9, 11, 12, 14 and 16 elements, **all providing broad coverage. 143.5 to 148.5MHz (without tuning)** plus exceptionally high gain.

A typical antenna: (KLM-144-148-14)
Elements: 14.
Gain: 14.2db (dipole reference)
Beam width: 18 degrees @ 3db pts.
Boom: 208" (5283mm). **Wgt.:** 9 lbs (4 KG)



NEW AZIMUTH ROTATOR

Model KR-400

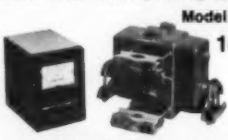
99.95

Ideal for most HF tribanders and VHF arrays. Medium duty w/electrical brake/limit switches. 1 minute/360 degrees. Rugged ... weatherproof. Attractive direction indicator.

NEW ELEVATION ROTATOR

Model KR-500

149.95



Use for OSCAR 6-7, Moonbounce, etc. Medium duty w/electrical brake/limit switches. 1 min./180 degrees. Rugged ... weatherproof. Attractive direction indicator.

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TT-45 FREESTANDING CRANK-UP TOWER, 45 Ft.
The TT-45 will support 9 sq. ft. at a height of 39 ft. freestanding when properly bracketed to a house or wall at the 8 ft. level. The loads decrease as the tower extension Mast is lengthened. (Loads are based at 50 mph and load permitted on the tower decreases with increases in wind speed over 50 mph). The tower can be completely freestanding with our new concrete or tower rotating bases, which allow the use of our raising fixture. Using these accessories, the towers can be installed by one man easily.

List $310.00

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All steel tubing is galvanized plated and conforms to ASTM specifications for years of maintenance free service. The SST-64 is made of 4 sections, being 4.5", 3.5", 2.5" and 2". These large diameters give unexcelled strength and virtually makes the thin push-up poles a thing of the past. The large loads of today's antennas make the Wilson SST-64 the best value on the market today.

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THE WILSON GT-46 GUYED CRANK-UP TOWER, 46 Ft.
The GT-46 features quality construction and materials, with the stability of the Guyed System.

FEATURES OF THE GT-46:
• Low cost • High capacity • all steel. Conforms to ASTM (American Standard of Testing Materials) • Fully galvanized • 800 lb. winch standard • Guy kits available for factory recommended installations • 2000 lb. raising cable standard (Aircraft Quality) • Can be roof mounted for extra height • Great looking, slim flag pole design, for the ecology minded.

List $219.00

DB33
WILSON 204
ROTOR CONTROL BOX
SST-64 CRANK-UP TOWER
WR 500 ROTOR
WR 1000 ROTOR

AMATEUR ANTENNAS

The Wilson 204 is the best and most economical antenna of its type on the market. Four elements on a 26' boom plus a Gamma Match (no balun required) make for high performance on CW & phone across the entire 20 meter band. The 204 Monobander is built rugged at the high stress points. Using taper swaged slotted tubing permits larger diameter tubing where it counts, for maximum strength with minimum wind loading.

The DB33 is the newest addition to the Wilson line of antennas. Designed for the amateur who wants a lightweight economical antenna package, the DB33 compliments the M204 for an excellent DXers combination.

All Wilson Monoband and Duoband beams have the following common features:

- Taper Swaged Tubing
- Full Compression Clamps
- No Holes Drilled in Elements
- 2" or 3" Aluminum Booms
- Adjustable 52 Ω Gamma Match
- Quality Aluminum
- Handle 4kw
- Heavy Extruded Element to Boom Mount

WR 1000 ROTOR

The Rotor everyone has been waiting years for — capable of the largest arrays up to 25 sq. ft.—Superior to prop pitches — Full 4,000 inch lbs. of turning torque. Braking system requires 12,000 inch lbs. before over-riding — accepts 2" - 3" masts — Weighs 60 lbs. — Size: 11" diameter, 19" high.

The Finest Rotor in the Market Today
WR 1000 . . . . $429.00 List

WR 500 ROTOR

The Wilson WR500 Rotor has 780 inch lbs. of turning torque before stalling.

In addition, a Special Braking System requires 1300 inch lbs. of torque before windmilling—This is more than twice the braking ability of the other comparable rotor being marketed.

Full 98 Steel Ball Bearing raceway assures elimination of side torque jamming when Rotor is mounted in line with the mast.

Recommended for antennas of 7.5 sq. ft. or less . . . weighs 20 lbs.

The WR500 Rotor . . $119.95 List

WILSON AMATEUR ANTENNA SPECIFICATIONS

Model No.	Frequency	Forward Gain (dB)	Front-to Back Ratio (dB)	Front-to Side Ratio (dB)	Boom Length (ft.)	Number Elements	Longest Elements (ft.)	Turning Radius (ft.)	Surface Area (sq. ft.)	Wind Loading at 80 mph (lbs.)	Assembled Weight (lbs.)	Shipping Weight (lbs.)	Price
M340	40	8.5	20	30	40	3	70'0"	39'0"	16	300	180	220	$749.00
M620	20	13.0	28	35	58	6	36'0"	32'0"	10.5	210	98	123	420.00
M520	20	12.0	26	30	40	5	36'4"	27'0"	8.75	175	74	96	299.00
M204	20	10.0	25	30	26	4	36'4"	22'6"	6.8	136	42	48	169.00
M203	20	8.5	20	30	19	3	36'0"	20'5"	5.25	106	35	40	129.00
M155	15	12.0	26	30	26	5	24'3"	18'0"	5.0	100	41	44	159.00
M154	15	10.0	25	30	19	4	24'3"	15'9"	4.0	80	30	33	109.00
M153	15	8.5	20	30	17	3	24'3"	14'0"	3.0	60	21	24	89.00
M108	10	13.5	28	30	40	8	18'0"	22'0"	5.5	110	48	77	219.00
M106	10	13.0	26	30	31	6	18'0"	16'1"	4.0	80	34	38	119.00
M105	10	12.0	26	30	28	5	18'0"	15'8"	3.0	60	29	32	109.00
M103	10	8.5	20	30	11½	3	18'0"	10'8"	2.0	40	10	12	39.00
DB54	20	12.0	26	30	40	5	36'4"	27'0"	12.75	255	84	119	349.00
	15	10.0	25	30		4	24'3"						
DB43	15	8.5	20	30	19	4	24'3"	15'8"	6.0	120	38	43	149.00
	10	10.0	25	30		3	18'0"						
DB33	15	8.5	20	30	17	3	24'3"	12'2"	4.5	90	30	33	109.00
	10	8.5	20	30		3	18'0"						

AVAILABLE THRU YOUR LOCAL DEALER

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ICOM IC-245
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Introducing the IC-245, 144-148 MHz FM Transceiver

The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The **IC-245** offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the **IC-245** puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The **IC-245** even comes equipped with a multiple pin Molex connector for remote control.

The **IC-245** is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your **IC-245** will give you the most for mobile.

SPECIFICATIONS

GENERAL	
Frequency Coverage	**144.00 to 148.00 MHz*
Modes	*FM (F3)* **SSB (A3J), CW (A1)*
Supply Voltage	*DC 13.8V±15%*
Size (mm)	*90H x 155W x 235D*
Weight (kg)	*2.7*
TRANSMITTER	
TX Output	*F3 10W* **A3J 10W (PEP), A1 10W*
Carrier Suppression	*40 dB or better*
Spurious Radiation	*−60 dB or less below carrier*
Maximum Frequency Deviation	*±5 KHz*
Microphone Impedance	*600 ohms*
RECEIVER:	
Sensitivity	**A3J, A1 0.5 microvolt input gives 10 dB S+N/N or better F3 0.6 microvolt or less for 20 dB quieting S+N+D/N at 1 microvolt input, 30 dB*
Squelch Threshold	*−8 dB or less (F3)*
Spurious Response	*−60 dB or better*
SYNTHESIZER:	
Frequency Range	*144 MHz to 148 MHz*
Step Size	*5 KHz for FM* **100 Hz or 5 KHz for SSB*
Stability	*per C in the range of −10 to +60 C, ±0.0000145% per C*

* Valid with SSB Adapter only

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COVER: The Kenwood TS-700A 2m all mode transceiver. Photo by Ed Crabtree.

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

Are your club meetings so much fun that at least 75% and often 90% of the club members come to each meeting . . . and you have a tough job getting them to go home after the meeting?

Okay, so a lot of clubs need ideas to get things moving. Before I throw some out on the table for you, I want to make sure that I get feedback. If you have any ideas going for your club that I don't mention, please do all of us a favor and send in a letter telling us about it. If some of my ideas perk things up, let us all know about that, too.

One of the functions of a ham club these days is to help recruit more hams. This means that all members of the club are delegated to do all they can to interest newcomers . . . getting out to CB meetings, giving talks at high schools, seeing that there are posters on the school and electronic firm bulletin boards in the area – and don't forget a poster in every Radio Shack, Lafayette, computer store, or place where CB or ham gear is sold, or where radio parts might be bought.

This process doesn't stop with the sparking of interest. Make sure your club is set to interest these people . . . classes for Novice . . . and then for Technician . . . and General. You might get things started around 7:00 with 20 minutes of code practice, though home practice with code cassettes will be a lot more productive . . . at least 15 minutes per day. Then you want to have a technical talk on fundamentals . . . another 20 minutes should be fine. Don't let these things drag. Start right on time, exactly, and members will be there on time.

Around 7:40 you can have a short business meeting. Have this as well orchestrated as possible . . . reports done quickly by each committee and officer. If there is going to be any argument on any subject, table it until after the meeting and let those interested enough in the subject to stay late and discuss it do that.

By 8:00 you should be ready for the main meeting and brief reports on special interest ham things . . . like what's been doing with DX, SSTV, nets, traffic, ATV, repeaters, the club training classes, etc. It wouldn't hurt to have a report on the content of the ham magazines, with one member reporting on each publication. I am always astounded to find some clubs where only a small percentage of the members are even aware of the material we have been publishing in *73* . . . I know there is little communication within that club. An amateur not getting *73* is losing a lot . . . the inspiration of the building articles . . . the knowledge of the state of art . . . the fuller picture on what is really happening with the FCC, the ARRL, the ITU, and so forth. And what a shame to miss out on an enormous library of articles on every ham subject. You never know when you are going to get fired up on RTTY, say, and desperately need to get caught up on it . . . so where are your back issues?

Keep the reports fast-paced and try to get to the main speaker by 8:30 (let him know your schedule so he won't have to sit through the business meeting if he is a visitor). Who can you get? Well, the club members with special interests are your first line . . . an SSTV demo and discussion . . . RTTY, microcomputers, DX talk . . . you know who your special people are. Going outside the club, you can tap ham manufacturers . . . they will go a long way to bring their latest product and talk about it.

How about DXpeditioners? They have interesting movies or slides and will get your club fired up for its own DXpedition (which isn't all that impossible, by the way). A local ham dealer will be glad to tell you of the problems and joys (which are few) of his business . . . and answer questions. Don't forget the contest fanatics, or the certificate hunters.

By 9:30 you should be ready for doughnuts and coffee or cider for about 15 minutes, then back to another short meeting to discuss club projects such as Field Day, emergency net plans, contest plans, special events. After that you can get to the tabled discussions until members start getting ready to go home. It is most helpful to try to put as much of the business which might drag on into a committee and keep away from whole club discussions. Oddly enough, members get all involved with very small matters (what color to paint the clubhouse) and argue for hours . . . seemingly enjoying themselves. But then they don't show up at any more meetings.

It's nice to leave a little time for members to lie to each other and (in general) talk at the end of the meeting. Those in a rush can get home – others can talk. Kick the last of them out by 11:00 . . . if they want to talk more they can go to a local pizza joint or something. This makes a nice windup for the evening.

Some clubs organize a dinner before the meeting at a nearby restaurant in the reasonable category. This is fun for those who enjoy having more of an opportunity to talk. If you get this going by 6:00, most fellows will be able to either make a short stop at home on the way or else go right from work.

Oh, and don't forget to have any members who get a new piece of ham gear bring it in and tell about it.

HOW TO TREAT SPEAKERS

If a speaker is coming in from any distance or is a special person of some sort, it wouldn't hurt to ask him out to dinner with a few members of the club before the meeting. This will give him a chance to get to know a little more about any special interests of the club – ask questions – and give enough information for a decent introduction.

Speakers should, in most cases, have their expenses of coming to the meeting reimbursed – particularly if it is a big deal for them. If you are flying them in, you'll meet them at the airport and red carpet things.

Many manufacturers will go to amazing lengths to help you out if you only contact them. I know that Ed Clegg has driven or flown hundreds of miles to talk with clubs, and many other ham manufacturers will do the same.

GETTING PUBLICITY

If you go to all the trouble to get in a really special speaker, you don't want a meeting with a couple dozen dozing members – you want to fill your room. Just passing the word over the repeater won't do it. Your club should have someone in charge of publicity . . . preferably someone who knows how to make posters, either with magic markers or via silk screen. Be sure that you have posters well ahead of time on every possible bulletin board . . . and club members should be able to tackle this. Supermarket bulletin boards, high schools, colleges, every Radio Shack within driving distance, Lafayette stores, CB watering holes, parts stores, ham stores, shopping malls . . . etc.

Posters are only the first step. News releases to the local papers and broadcasting media can help, too. Next you want to be sure the info is in the club newsletter . . . on the repeater a lot . . . on any low band nets . . . then try

Continued on page 167

If you haven't tried the TS-700A ...you haven't experienced the excitement of 2-meters

REPEATER
DRIVE
TS-700A
KENWOOD 2m ALL MODE TRANSCEIVER
POWER
SEND
CEN
NB
RIT
TONE
OFF
REC
S
MIC
PHONES
MODE
FM
CW
USB
LSB
AM
OFF
LSB
USB

TS-700A Specifications

TRANSMIT/RECEIVE FREQUENCY RANGE: 144-148 MHz
MODE: SSB, FM, CW, AM
RF OUTPUT: CW, FM: more than 10W output. AM: more than 3W output. SSB: more than 20W DC input.
ANTENNA IMPEDANCE: 50Ω (unbalanced)
CARRIER SUPPRESSION: Better than 40 dB
SIDE-BAND SUPPRESSION: Better than 40 dB
SPURIOUS RADIATION: Less than −60 db
MAX. FREQUENCY DEVIATION (FM): ±5 kHz
REPEATER FREQUENCY SHIFT WIDTH: 600 kHz
TONE BURST TIME: 0.5-1.0 sec.
MODULATION: Balanced modulation for SSB. Variable reactance frequency shift for FM. Low power modulation for AM.
MICROPHONE: Dynamic microphone, 500Ω
AUDIO FREQUENCY RESPONSE: 400-2600 Hz, within −9 db
RECEIVING SYSTEM: SSB, CW, AM: Single-superheterodyne. FM: Double-superheterodyne.
INTERMEDIATE FREQUENCY: SSB, CW, AM: 10.7 MHz. FM: 1st IF: ...10.7 MHz. 2nd IF: ...455 kHz.
RECEIVING SENSITIVITY: SSB, CW: S/N = 10 dB or better at 0.25μV. 20 dB noise quieting = Less than 0.4μV. AM: S/N = 10 dB or better at 1μV.
IMAGE RATIO: Better than 60 dB
IF REJECTION: Better than 60dB
PASS-BANDWIDTH: SSB, CW, AM: More than 2.4 kHz at −6 dB. FM: More than 12 kHz at −6 dB.
RECEIVER SELECTIVITY: SSB, CW, AM: Less than 4.8 kHz at −60 dB. FM: Less than 24 kHz at −60 dB.
SQUELCH SENSITIVITY: 0.25μV
AUDIO OUTPUT: More than 2W at 8Ω load (10% distortion)
RECEIVER LOAD IMPEDANCE: 8Ω
FREQUENCY STABILITY: Within ±2 kHz during one hour after one minute of warm-up, and within 150 Hz during any 30 minute period thereafter.
POWER CONSUMPTION: Transmit mode: 95W (AC 120/220V), 4A (DC 13.8V), max. Receive mode (no signal): 45W (AC 120/220V), 0.8A (DC 13.8V).
POWER REQUIREMENTS: AC 120/220V, 50/60 Hz. DC 12-16V (13.8V as reference).
DIMENSIONS: 278 (W) x 124 (H) x 320 (D) mm
WEIGHT: 11 kg
SUGGESTED PRICE: $700.00

Prices subject to change without notice

Experience the excitement of 2 meters. There's more than just FM repeaters, you know. SSB DX, OSCAR Satellite, CW...and do it all with a tunable VFO. Do it all with the Kenwood TS-700A.

- Operates all modes: SSB (upper & lower), FM, AM, and CW
- Completely solid state circuitry provides stable, long lasting, trouble-free operation
- AC and DC capability. Can operate from your car, boat, or as a base station through its built-in power supply
- 4 MHz band coverage (144 to 148 MHz) instead of the usual 2
- Automatically switches transmit frequency 600 KHz for repeater operation — reverses too
- Outstanding frequency stability provided through the use of FET VFO
- Zero center discriminator meter
- Transmit/Receive capability on 44 channels with 11 crystals
- Complete with microphone and built-in speaker

The TS-700A is available at select Kenwood dealers throughout the U.S. For the name of your nearest dealer, please write.

KENWOOD
...pacesetter in amateur radio

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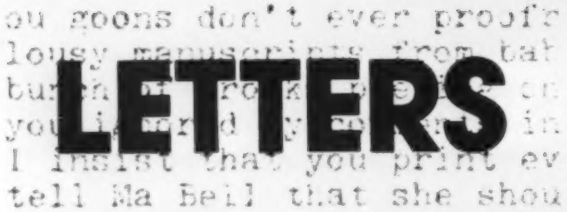
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tell Ma Bell that she shou

LETTERS

REFUNDED IN FULL

Re Trigger Electronics: 8 years ago I was the proud owner of a Novice ticket and wanted to assemble a commercially-made CW xmtr for my shack. Trigger had the kit I wanted for sale and I innocently sent off the money. What arrived, however, was *not* the kit advertised, but the same rig, fully assembled, and *used*.

I was extremely disappointed and fired off a letter to Trigger. After several additional letters and having received no satisfaction from Trigger, I told them in a final letter that it was either my money back or I would send their ad (in *QST*) from which I ordered the kit, together with their sales slip and a letter of explanation to the ARRL, requesting that the League arbitrate the matter.

This prompted Trigger to refund my money in full.

I no longer subscribe to *QST* and don't know if Trigger still places ads in that monthly, but the moral seems to be: If Trigger is playing a number on you, hit 'em where they advertise!

D. Nevin WA1KLB
Northfield VT

73 is forwarding all Trigger complaints to the Illinois Attorney General for action. — Wayne.

IL VS TRIGGER

This office has on file material relating to complaints made concerning Trigger Electronics. This letter is to inform you of the status of our case against Trigger.

An amended complaint was filed against Trigger on October 8, 1976. In addition to an injunction against further advertising by and against continuing in business, we are seeking the appointment of a receiver to marshall such assets as the owner, Mr. Irael Treger, may still have, which would then be paid out *pro rata* to all persons who have complaints on file with this office.

It will be some time before the case will go to trial and, of course, we can promise no favorable results. Please be patient, however, since we hope for progress in this case soon.

Finally, I would appreciate it very much if those of you who have filed complaints would do the following:

1. If you have moved since your complaint was filed, please inform me of your new address.
2. If Mr. Treger has made refunds to you or shipped merchandise ordered by you, please inform me so we can present up-to-date files to the court when the time comes.

Thank you very much for your cooperation.

Jonathan T. McPhee
Consumer Fraud Division
Attorney General
State of Illinois
134 N. La Salle St.
Chicago IL 60602

BAIT AND SWITCH

Yesterday I called Moory Electronics Company in DeWitt, Arkansas, in response to an ad on page 174 of the October *QST*. They had a number of specials listed, including one for a "demo Ham-2 rotor — $99." When I asked about it, the young lady who answered the phone informed me that it had been sold long ago and probably had left their place of business even before their first ad came out about it. However, they could supply a new unit for only $129.95 if I would place an order. The young lady I talked with further admitted that the ad was intentionally left in because it attracted lots of attention and got them in touch with many hams who might otherwise call a competitor. I did not buy anything from this company. This type of advertising is illegal in Colorado and is known as bait and switch. It consists of advertising some product at a low price and then when a prospective buyer shows up, the salesman informs him that the store either had only one of a kind in stock and that one was sold or that the advertised item is inferior in some way and should not be considered; HOWEVER, for only a few dollars more we have . . .

This incident and stories of problems that other hams have in regard to Trigger Electronics lead me to believe that we need protection from the mail order business. By we, I mean not only the prospective buyer, but the legitimate dealers who are trying their best to make a living and give fair and honest deals, too. Some possible solutions come to mind.

1. All amateur radio magazines should refuse commercial concerns advertising space in the classified sections of their magazines.
2. All commercial concerns advertising in a magazine should have to file an affidavit that they do indeed have a reasonable number of the advertised special in stock to meet reasonable demands. One of a kind specials should be discouraged, especially if they are likely to be sold out before the magazine reaches its readers.
3. We have groups of hams working as official observers, intruder watch, etc. Perhaps one more group could be formed for consumer protection. They could arbitrate legitimate differences between buyers and vendors and report unfair practices to each publication. Then each editor would have the option of stopping the unfair advertising practice.

There are probably other solutions and ways to handle this unfortunate situation and I would like to see them discussed. I would hope that there would be input from both prospective buyers and the merchants who make their living through pages of amateur radio publications.

Royal R. Maxwell WA0QFY
Craig CO

NT7HEL

How do you have fun and gain rare status at the same time? Get a Special Events License! For our Helldorado Days Celebration of 15-16-17 October, I was issued NT7HEL. In 33 hours of operation, two friends — Dale AD7RDG and Don AD7NEQ — and I made exactly 1001 contacts. It was almost a continuous pile-up! I made the mistake (?) of turning the beam west to pick up a KH6 on 15 meters and half the hams in Japan jumped us. We worked 90 in one hour and 5 minutes of the heaviest pile-up I've ever seen. We had to break them down into individual prefixes: JA1, JD1, JG1, JH1, JI1, JJ1, etc.

Now the fun is over and the cards have started to come in. And I'm learning. When I gave out QSL information I requested an SASE since this is all coming out of my pocket and I could see a thousand 13¢ stamps coming out of the budget. Out of 192 cards received so far, 25 failed to provide an SASE. Those go to the bottom of the pile.

An even bigger surprise has to do with the time a contact was made. I thought that Universal time was universally used. NOT SO! 7 cards didn't show any time. To the bottom of the pile with them. 42 cards either used local time or used Universal incorrectly. There must be more time zones in the USA than I thought, because some of the abbreviations haven't been figured out yet. What's PMEDT? Some contacts for the evening hours show the correct time but the previous day — failure to advance the day when 2400 UTC passes. You ought to put together a short article on the use of UTC and urge everyone who works over time zone lines to use it. I'd do it myself but I'll be on the road for the next four weeks.

It really was a ball and I'm looking forward to the next one. If you could use an article on the operation of a Special Events station, let me know and I'll knock it out when I get settled down again.

Rod Hallen AA7NEV
Tombstone AZ

P.S. I'm a stamp collector, so envelopes with commemorative stamps are always processed first. Some QSL cards are very hard to decipher. The cards that have the boxes to fill in on the front are the easiest to read. Some of the cards with the report on the back don't leave much room to write, which makes it hard for the recipient to read. Also annoying is having the call on one side and the report on the other. Little things, but they add up when you have a lot of cards to process. I'm much more in sympathy with QSL managers and DX stations. I'm going to redesign my own card and get some printed soon.

MORE YASME

This is a report on the successful YASME DXpedition by Lloyd and Iris Colvin operating on St. Thomas, US Virgin Islands as W6KG/AJ3.

Including operation in the phone portion of the CQ-WW-DX Contest, some 6,800 QSOs were made. Operation was from 8 October through 31 October 1976. QSOs were made with radio amateurs in 125 different countries. Conditions were better than normal and it appears that the sunspot cycle must indeed be on the upswing. For example, WAC was made on 7 MHz on 18 October in 3 hours and 50 minutes. Stations worked were 4X4GD, VK1RM, G3ZDW, W2PN, PY1NEW and CN8AD. On 27 October, WAC was made on 14 MHz in 60 minutes. Stations worked were ZS1XR, OE1UZ, VK2QL, UI8IZ, W1BFT and PY1EUM.

Lloyd Colvin W6KG
Iris Colvin W6QL
Beef Island

THE OPPOSITION

In one of your recent columns, you asked for some input from your readers on the constant argument of ICs, computers, etc., vs the more traditional ham equipment and activities. I think enough of your magazine and your viewpoint to tender my reply.

I must side with the opposition. I'm still struggling along with my WN callsign, and 15 wpm seems to be an impossible dream. To read articles on keyers capable of 60 wpm, rotator brakes, etc., just turns me off. And though your magazine is by far the best I've seen regarding articles for amateurs who are either Novices or new Generals, I don't like the trend I see toward more and more of the esoteric.

Maybe I am expecting too much, but what I need is help in the basics: How do I put out a readable signal when I am a renter (no beam antennas on the roof, no 250 foot long antenna wires out of the window), using the only equipment available to me (a transmitter no one else has ever even heard of, a Globe DSB-100, and an Allied receiver that more or less works, sometimes, I think, maybe?), and when I must compete with $2000 rigs that put out more Watts than my rig could generate in the destruct mode? And I can't help but feel that many other hams find themselves in the same fix. Those of us in this fix don't need articles on a super wide band antenna built at reasonable cost (who says $100-$200 is reasonable?), when that antenna requires 300 square feet of unobstructed land. What we need is an article on how to make do with a homemade 30' vertical that is standing in the middle of my tomato garden, the only spot open for it. Loading, swr, radiation pattern . . . ? I don't have any idea, and really don't care, because it is all I have, and it has to make do. But why won't someone tell me how to make it work better? Every antenna article I've ever read, in *73*, *QST*, *Ham Radio*, *Antenna Handbook*, etc., starts off on the unstated premise that the interested ham has unlimited funds and ½ of Kansas at his disposal to play with. But it just isn't so!!

Regarding the argument about ICs . . . yes, I agree they are the thing of the future. As surely as transistors pushed out tubes, ICs will soon be the *only* thing. I'm sort of sorry to see them go, but it will happen nonetheless. But granting this, that ICs are here to stay, does it follow then that every application of ICs should be of interest to hams? I refer, of course, to computers, microcomputers, microprocessors or whatever. To my mind, this entire field of computers is separate and distinct from ham radio — perhaps related and perhaps useful, but distinct nonetheless. I respect your interest in the magic boxes, but it isn't for me and I rather resent its intrusion into a ham magazine, except if it is directly applicable to ham radio.

Along this latter line, let me tell you one more peeve I have. Your magazine (and many others as well) keeps showing articles on computers that can call CQ, answer calls, log the entry, dump the contact if it's a duplicate and in general handle the entire contact except for a few blanks the operator must fill in, such as RST reports. My question is this: What is ham radio all about? Where is the dedicated amateur, twisting dials, fighting QRM, and sharing contacts with other people? If I want to have a computer do my contacting for me, I pick up my telephone. My ham gear is for fun, people-type fun, not machines. Sure, the computer is more efficient, but is it ham radio? I personally hope not. This is one of those situations where progress may be at too great a price, a price paid in the loss of personal contact, personal exchange, and loss of a great heritage of people dealing with people.

I'm sorry I rambled on, Wayne, but as I said at the outset, your magazine means something special to me, and I felt it worth the effort in writing all of this to you.

Keep on pushing for hams and ham radio. Your voice calling in the wilderness will be heard; such voices always are, eventually.

John P. Cranston, MD WN2DYU
Corning NY

P.S. Along the same lines, why is it that amateur gear is so expensive? The units are mass produced, are not especially complex, and yet are offered at prices that are virtually unreachable. An antenna made up of $10.00 worth of aluminum, a few dollars of hardware, and based on no exotic research, is marketed for 50+ dollars. Transceivers are outrageous, accessories untouchable! Who is playing whom for the sucker here? How about a voice for the ham who doesn't have a multi-hundred dollar budget for his hobby, crying for a good but simple and inexpensive unit, without all the frills and gadgets, but functionally sound (I for one am still quite happy reading dials, and can really see them as well as I can see LEDs glowing their pretty $$$)? Thanks again.

Ham gear expensive? Hmmm. There are several reasons, and perhaps this will be of interest. First, let's take a quickie back through memory lane to 35 years ago. I ran across the invoice the other day for my T-125 tube — $12.50! To put that into perspective, I was working a 45 hour week at the time and making $40 as chief engineer of a broadcast station. That 125 Watt tube cost about one third of a week's pay. The crummiest receiver available, the Hallicrafters Sky Buddy, was about $20 — half a week's pay . . . and it was pretty poor. How much does the chief engineer of a 1000 Watt broadcast station get today? Probably over $300 a week, so you compare value of ham gear then with now. Okay, now as to how the figures mount up. First comes the matter of the cost of designing and prototyping the circuit — then the mechanical parts which have to be made specially — have you priced cabinets recently? The manufacturer has to count in the cost of parts, of following up on the parts orders and trying to get delivery, of storage space and inventory control of parts, of testing and returning bum parts, of phone calls and letters trying to get replacements for bum parts, of salaries for the people to do all of this, of getting PC boards made, of checking them on delivery, of assembling the equipment, testing it, having the package designed and made specially for the equipment, packing it, writing the instruction books, having them published, writing the advertising, the cost of ads (which is not insignificant), answering letters from customers, writing and publishing specification sheets and booklets, overhead of the building, heating, telephone, payroll taxes, management costs, banking costs, Master Charge commissions, 25-40% extra for the dealers, 10% for the manufacturer's representative, maybe a little profit for the manufacturer, shipping costs of everything involved, costs of repairs and the records and bookkeeping involved, support of an accounting firm and their dependents, support of at least one lawyer and his firm, his telephone, etc. It mounts up. Did I mention the costs of attending conventions? Only mighty rough competition keeps the costs of ham gear from going out of sight — the fact is it takes a very tight-fisted firm to compete and no one that I know of is getting rich. — Wayne.

MORE OPPOSITION

In one issue — or two — of *73*, you asked for opinions on the I/O portion of *73*.

I have approximately every copy of *73*, *CQ* and *QST* for the past 23 years. I have dropped *CQ* as of 2 years ago; I will drop *73* whenever the subscription expires. I like the radio portion — always have — but the I/O section I consider a poor "filler." It takes the place of ads of amateur radio gear — and articles.

I am not against learning something new as you implied to anyone beefing against this crap — but simply confine my interests in solid state to communications items. I would enjoy advertisements much more. As it is, most advertisement is for I/O parts and associated trash — very little radio! Why claim a "radio magazine" when over 60% is totally unrelated electronics? Along with the change of size and format, why not change the title to reflect what it really contains? It isn't amateur radio!

N. P. Walker W5GOS
Midland TX

CQ 11m?

To: Federal Communications Commission
CB and Amateur Department
Rule Change Section
Washington DC 20554

Re: Petition to Change Rules and Regulations. Proposed rule and regulation change permitting amateur use of the 11 meter CB band and other CB bands; requiring amateurs to abide by all CB rules and regulations; permitting the use of amateur station callsign, rather than the CB callsign.

Dear Sirs:

This is to request a change of rules and regulations permitting the use of the 11 meter CB band and other CB bands by amateur station licensees, subject to all CB rules and regulations. The only change would be the use of the amateur station callsign rather than a CB station call. Rules for obtaining a CB license, in this instance, would not be pertinent, since license was obtained in an amateur manner. Amateurs, when operating in the CB bands, would be considered CBers as far as International Treaty or the like. All classes, Novice through Extra, would be affected. Commercial use of the amateur callsign in this instance would not be prohibited.

Discussion *PRO* change of rules:

1. Amateurs will act as "goodwill ambassadors" possibly encouraging a certain portion of CB operators to become hams. This would be a positive effort to aid the FCC in the control of the "CB problem." Hams are on the "FCC side" and are of positive help and aid.
2. Change of Rules and Regulations would pose no problem in implementation and cause no additional government cost for administration.
3. Approximately 280,000 less CB callsigns would be necessary to be issued by the FCC — a saving in government operating cost. (There are approximately 280,000 hams.)
4. In keeping with the stated FCC policy of "deregulating hams."
5. Historically the 11 meter band was a ham band — such a return is feasible.

Discussion *CON* change of rules:

1. I can't think of any disadvantages or con — the change of rules and regulations is positive and constructive.

Please acknowledge my petition — then let me know your decision.

John K. Lassig K5GFV/W5IOV
2025 Bingle Road
Houston TX 77055

LOW PRIORITY

Another childhood illusion shattered — namely that if you get ripped off via the mails that Big Daddy will make it all better.

About one year ago Environmental Products went down the drain. They had an excellent newsletter that I had subscribed to. One of the surviving principals offered through the mails to keep the newsletter going. I sent money and got nothing in return. After a decent interval of waiting (some six months), I entered a formal protest with the proper postal authorities.

My notification of the ripoff went to the Postal Inspector in charge out in Denver CO. One grand hell of a time later, this gentleman finally notified me that a United States district attorney had investigated the firm and had "declined to prosecute." I was further advised that I could write to a Mr. John R. McKown in Colorado, who had indicated that he would stand good for the loss. To date nothing has been heard further on the matter.

Perhaps if you were a large company who had access to a legal staff to press the matter of why a mail ripoff is allowed to go unprosecuted, you might stand a chance of making recovery. As a lone individual, it seems that Uncle Sam really does not care. If you do not pay your taxes, that is one thing . . . if you look for some service for your tax money, evidently that is a matter of a much lower priority.

Allan S. Joffe W3KBM
Dresher PA

THE HFers

Lots of activity on 11 meters out here — both in and out of the band. Most any evening I can find 6 or more QSOs between 27.255 and 27.500, on SSB mostly. Heard one fellow brag about his new $850 imported SSB rig on 27.400 — didn't seem to know he was illegal as all get out. Several times I have found SSB QSOs in the low end of ten meters. All I can do is tune up and call CQ on CW — seems to discourage them for several days. Is there any way to talk to them within the law? I think they would be happy to start classes somewhere if they could without any hassle or someone putting them down. I think we who communicate by radio need a "common band" where anyone can operate regardless of license class — maybe our ham tickets could be made to include some operation on 11 meters. If these people sat in on a net once or twice they would see that a ham ticket is worth its weight and a very desirable thing to have.

That's all for now. My pen still can't spell but I keep trying.

John E. Winter WB6EUK
Garden Grove CA

KUDOS–HEATH

We hear a lot about dirty deals hams get from the different dealers. No doubt they get comments which reflect the abuse felt by those who resent it the most, but we are taking for granted the good treatment received from the majority of the dealers. A case in point is as follows: On March 15, 1976, I ordered an HW-101 from Heath and did not get around to putting it together for four months. About six weeks ago I got out the kit and started to put it together, since I was unable to previously due to college work.

I found at first that the mode switch was defective as it had one of the wiper contacts missing. Having an assortment of switches, I robbed one of its contact and restored the switch, but wrote Heath about a new switch so I wouldn't have to worry about it later. In less than 10 days a new switch arrived, no charge. Then I found a bad carrier oscillator crystal which they also promptly replaced; in fact, it was removed from one of their working units (a prototype, probably) so I wouldn't have to suffer a six week delay when ordering a single unit from their supplier!

I've built the SB-102, SB-200, Heath wattmeters, scopes, tunnel dippers, transistor checkers, etc., and outside of one other bad transistor, they've been 100% good. Then to receive replacement parts after the warranty period has expired is uncommon and laudatory.

I also commend them on sticking with the amateur fraternity when other manufacturers have moved to some specialized part of communications which provides a quicker cash profit.

So when it comes time to relieve the pressure that has been building up in some little bank account somewhere, we should remember those who've stuck with us and provided good service through the years. When other manufacturers and dealers begin to realize that good service attracts good customers, perhaps the practice will spread. It should be encouraged!

Now . . . how much was the HW-104? Hmmm!

Robert B. Lunsford, Jr. WB5OGI
Killeen TX

REFLECTIONS

Thanks for your article, "Exploding The Power Myth," in December, 1976 of *73*.

For approximately a quarter of a century, off and on, I have studied and restudied reflected power. It has always bugged me, as I have never been able to grasp how power can be reflected backwards. As the articles I was studying came from such reliable sources as the ARRL and college textbooks, I felt I was lacking in mentality and ready to turn in my EE degree and Mensa pin. When *QST* carried a lengthy series of 3 articles on this subject about a year ago, you know I was upset when I was confused once again.

However, I do believe that you, through *73*, have started to set the record straight . . . there is no such thing as reflected power. I hope the ARRL corrects its publications.

William Richrath K9IEN
Elmhurst IL

APPLES 'n ORANGES

Thanks for forwarding me a copy of the *HR* article of August, 1976 by W2DU which talks of coaxial dipole antennas and mentions my *73* article of June, 1973. I don't subscribe to *HR* because it often seems to be just an outlet for frustrated theorists who can't publish in *QST*.

The need for W2DU's ungentlemanly and inaccurate footnote escapes me. He tries to sound very professional but he is comparing apples and oranges. My *73* article was mainly a practical construction article of 2½ pages (old, small page size) while he presents a rambling 14 page (new, large page size) mathematical exposé which concludes that the advantages many amateurs found in practice for the coaxial dipole configuration are not theoretically supportable. His statement that I said 50 Ohm transmission line "must" be used is incorrect. I said one should use 50 Ohm line because of constructional convenience.

He clouds a possibly better understanding of the antenna systems we use — which any open-minded amateur would welcome — with arrogant insult to other amateurs who have experimented in the antenna field. I am surprised the editor of *HR* would accept such material.

John Schultz W2EEY/K3EZ
73 Magazine Staff

AWE AND RHAPSODY

I well remember evenings and weekends spent in awe and rhapsody over many a back issue of *73*, some going back to 1960 and 1961, when they were 37¢ (two for 73¢!). The excitement was heightened all the more by the undergraduate pressure of hard study, nagging me that I should be doing something else . . .

But those days were vividly recalled as I paged through the histories, biographies, and thought-provoking fictions in your November '76 issue. Back came some of the previous stories I'd seen on the wildly imaginative but forgotten genius Tesla — aided by that wonderful high-voltage explosion of sparks in the photograph. Perhaps the best service Harry Goldman did for both Tesla and myself was the extensive bibliography attached to the article. I'm glad *73* hasn't let this man's energies go loose in history and has kept up with his founding work on ac electricity.

Then there's Ken Cole's marvelous account of his experiences in WW II. If there was an award given for the best amateur radio magazine article of the year, "Paolo" should win it. Cole's style kept up the haunting mistiness of the whole adventure, while the photos drove home the realistic tensions of the war. Human interaction, across "enemy" lines, an interest in radio as a hobby, and history all very well interwoven into a readable, believable account.

Rexford and Emelie Matlack's research on "The Quiet Spy" came through well as the story unravelled — newspaper clippings and photos from old magazines added to the realism. I think this kind of work is not a sick kind of return to the nostalgic "good old days," but rather a service to younger hams who can begin to appreciate the obvious richness and diversity of service (and fun) the hobby provides.

And along those lines, Howard Burgess' notes on pioneer efforts directly related to amateur radio seem to pull all these human interest/historical stories into the present: What can we, as experimenters, do *now* with our knowledge and inherent bent for fooling around without strict recourse to the sometimes stifling methods of science? After all, it's usually the amateur generation who break from the past and make new discoveries — if you need a source of these freer minds, look at the work being done in microprocessor control of repeaters or RTTY stations. "Who, Me? A Pioneer?" invites some serious thinking on everyone's part to say yes when all others shrink away from a problem and think you're crazy.

All this and the bodily resurrection of Hank Olson's S-38 too! The best thing to do with that beloved excuse for a receiver is to dump it into the bay or the harbor, depending if you're still in San Francisco or near Boston.

An excellent magazine, Wayne.

Rick Ferranti WA6NCX/1
Cambridge MA

P.S. Was that really you on .52 a couple of weeks ago, mobiling on the way to Tufts Radio? I moved out to this area a month ago for the even more dreaded occupation of graduate school, and found Tufts Radio to be an excellent and friendly place to spend my rapidly dwindling cash. As you may suspect, I have another article in preparation to help alleviate that situation!

Yep, 't was me . . . and thanks for the nice letter. — Wayne.

JAMMING

Congratulations on a fine magazine. Really enjoy your articles over *QST;* they are well-written and easy to understand.

Please find enclosed my check to cover my subscription and a tape.

I only have one complaint. I was listening around 3960 the other night and heard something that made me sick. K6GBG was in QSO with a friend and some jerk jammed him unmercifully. I am wondering what has happened to ham radio. I haven't yet seen a rig without a knob to change the frequency.

If you hams are as proud of your ticket as I am of mine, you will abolish this kind of activity on our bands (the jammer wouldn't even give his call letters).

Thanks again for a fine mag and a great hobby.

G. D. Ross WB7EBA
Medford OR

THE GREEN PHILOSOPHY

Here is my 3 year renewal to *73 Magazine*. At 18 dollars it is a real bargain.

Here also are a few comments that may be of interest to you. I must reluctantly say that *73 Magazine* is probably about the best of all the ham and "popular" types of electronics magazines. I wish I could say the same for its publisher. I often get the feeling that *73* has, and perhaps always was, more of a personal journal than a vehicle for other hams than yourself, though it is that, too — even if not entirely intended that way. It's sort of a soapbox for you, on which to vent your feelings, espouse causes and screech at the top of your lungs on anything and everything that catches your attention and/or fancy.

As long as I'm at truth saying, I may as well add that there are times that you sound pretty much like a NUT! At other times you are a genuine All American Ham Hero. I've been in ham radio long enough to have followed your career from the start at *CQ Magazine*. You are, to say the least, unpredictable and ruthless to a large degree. You have had failures along the road but all have led to your current success, which is very probably the envy of many others who might have dreamed of doing the same that you have done, or, at least, in being in the same lofty position you now hold. You are much like that childhood poem: "When she was good she was very, very good; When she was bad she was horrid."

The big plus on your side is that you have made *73* the best all around ham magazine. So I am going to stick to *73* and let my subscriptions to all the others, including *QST*, drop. *QST* once was a marvelous publication, with the best in everything that the ham, or prospective ham, might ever want. The latest in construction — at all levels of advancement. A great sense of humor, especially in those once delightful "Strays." Unfortunately, the humor, as well as the quality of interesting articles, has pretty well disappeared. The pages of *QST* are filled with bland trivia that takes a great effort to justify in the minds of the average Mr. Ordinary Ham, like me. As for *Ham Radio*, it's OK, but I like *73* better. So for economic reasons I am discontinuing that publication. As for *CQ Magazine*, the less said the better. *Popular Electronics* and *Radio-Electronics* cater almost entirely to CB now, so they, too, will have to be discontinued.

I'm truly sorry to hear that you are eliminating most of the computer articles from *73*, in favor of starting up another publication, *Kilobaud*, in which they will all appear. Looks like I will have to do without them for the above stated economic reasons. $15 for that new magazine, plus the cost of *73*, is more than I can afford. So it will be *73* only from now on, much as I regret having to say that. And for the same reason I will be giving up *Byte Magazine*. There you have it. I am sure that my words reflect somewhat the same thoughts many other readers of *73* have about you and about *73*.

Mack O. Santer W2ZPW
Brooklyn NY

All of us were surprised to hear from you that we are eliminating computer articles from 73. *As far as being a nut is concerned . . . that's okay with me . . . unless you can show me some sane person who has accomplished anything of real benefit to the world. My basic goal is to bring as much fun as possible to as many people as possible . . . and use this as a way to perhaps move the world ahead just a notch or two as a by-product. My dais is open for business. I use it to express my ideas, but I'm willing to step down for anyone with a piece to write, whether I agree or not. As far as I know,* 73 *has the only open pages for such matters. — Wayne.*

PLEASE—NO AGC!

First, I'll bite again for another of your "rags" (3rd one).

We have cussed and discussed items before. Know you won't remember, but I wouldn't either in your place (too many to remember all).

I will get around to making copies of the USN code tapes I have one of these days. Too much going on here all the time. Please redo your code tapes on a machine without agc. The pumping is bothersome.

Add to your Ham Help column: We (The Wiregrass Amateur Radio Club) sponsor amateur classes via George Wallace Junior College. Novice classes run 10 to 12 weeks twice a year, starting September and March. General classes start in September and run 9 months if needed.

This is the way to operate such classes. The college takes care of everything except the actual teaching. The $10 fee keeps out the mildly curious. So far, after 3 Novice classes and 1 General, we have over 30 new hams in this area. Almost an exact double over 1½ years ago. Most of them are ex-CBers. We make sure the local CB crowd knows about the classes. Don't knock them — get them to join.

Roy Dancy
Dothan AL

CROSSED WIRES

I have just finished reading the letters portion of your magazine and was especially interested in the fellow who was giving up ham radio because of snobbishness.

I would like to advise him that I think he is misconstruing snobbishness with successful endeavors. I feel that when he visits some ham, most of whom are fair to well off, he is overwhelmed by the settings and the elaborate equipment, casts himself into an inferiority complex and cannot recover.

The amateur fraternity is on a fairly high plane and while most well-off amateurs do their best to make themselves understood, the evidence of comfortable living is self-evident and cannot be denied. Again, I consider this to be the underlying factor and it makes the newcomer of limited means very self-conscious. It cannot be helped and I know how he feels, for it is somewhat disconcerting to visit and see a lot of gear that goes to a sum of $5000.00 or better.

Maybe some hams puff up, but I am sure that it is pride more than aloofness, and I say that it is something that they earned. So, again, I think that the fellow that wrote in about snobbishness has some of his wires crossed. I know that I, for one, am overwhelmed by some of the new gear that some of my friends have, but I do not begrudge them; I only envy them and try to do better myself.

So that is my answer and I hope that maybe we can salvage this fellow.

Jack Golden WA2YPW
Portville NY

THE GOLDEN HELMET

As an editor, you should know better than to generalize in your statements. As a ham, you don't seem to be very knowledgeable regarding license classification.

You remind me of the Monsignor of an Irish parish who was very perturbed because one of his parishioners was baptized in a Polish church. I do suppose that a difference between 5 and 13 words per minute does emphasize a great intellectual difference in an individual whose cranial capacity seems to greatly exceed the capacity therein.

As a Technician, I couldn't care less regarding the phone part of the 10 meter band. As an amateur, I suggest that you read the amateur's code, parts one and four.

You remind me of the painting by Rembrandt, "The Man in the Golden Helmet," the old warrior dressed in a gilded uniform with only the memories of the past shutting out those of the future. The Technicians have committed much to the prestige of amateur radio, i.e., the 2 meter halo, TVI filters and many others.

Ham radio, because of attitudes like yours and your snobbish caste set, has taken a back seat to CB and has all but vanquished ham supply stores with fully stocked shelves. Fortunately there are still hams with a sense of human values who strive to build up and encourage the art rather than tear it down with their envy. Your name typifies your character.

John B. Swiencicki K2KMU
Parsippany-Troy Hills NJ

Right on. — Wayne.

A FREE RIDE?

Nearly every issue of *73* has at least one complaint about the code requirement (for amateur licenses) in the letters to the editor column. They remind me very much of the sort of complaints we get from students wanting to be relieved of graduation requirements (I teach at U of Ill.). They want to be relieved of the responsibility for language or math or science courses (the "hard ones"), but they still want a degree labeled "Liberal Arts." Their complaints invariably come down to the fact that they consider the courses difficult and want a free ride. Of course, they rationalize their objections by arguing that the courses are not "relevant." More often than not, these objections come from students too narrow to see beyond their immediate wants.

The principal justification for the amateur radio service is that it is a public service. The FCC study guides even indicate that one purpose of amateur radio is to provide a corps of qualified operators for the military and civilian communications systems in times of war. That — obviously — means operators qualified to use the Morse code, because that mode, more than any other, provides reliable communications at low power levels. Note that *all* the military services still use Morse trained operators. A ten Watt "Angry 109" can do yeoman service on CW in conditions that would put most phone stations out of service. Morse code is far from being, as one complaining letter argued, an outdated mode of communication. It works when others will not. I might also point out that most of our public service traffic nets are on CW and that MARS conducts many such nets.

It also is not true, as Wayne Green once argued, that few amateurs still use CW. If he would bother to come down on the CW bands, he would know that they are as crowded as the phone bands, but that most CW operators run 200 Watts or less. The CW bands tend to be a refuge for those operators who want to communicate, but who lack the money to buy the linear needed to compete on the phone bands. They're willing to work just a little harder than those at the top end of the band.

I find it interesting that so many who consider themselves bright enough to pass the electronic written are willing to admit that they cannot learn the alphabet. That is not a high price for the privilege of being an amateur radio operator. It may be a reasonable minimum. As a professor of economics once put it, "The cheaper a product, the less it is likely to be respected, and the more it is likely to be abused."

David G. Boyd WA9GBW
Collinsville IL

MORE WARC

The following are some of my personal observations. On September 29, 1976, a meeting was held between representatives of the CRTPB (Canadian Radio Television Planning Board) and DOC in Ottawa, for the purpose of discussing proposals of how to rearrange the frequency spectrum between 406 and 960 MHz. The submissions of this and further meetings will be used as a guide by the

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Looking *West*

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Let's call this the "putting one's money where one's mouth is" department. For months now I have been telling you all to go forth and try to get your local CBers interested in becoming amateurs, getting them into training programs, inviting them to radio club meetings, offering to speak at CB "breaks," etc. Well, if you are going to try to meet some of the local CBers in your area, there is really only one place to meet them: on their band, their home territory — 11 meters itself. Why not? Eleven meter radios, the 23 channel variety, have been tumbling in price ever since the Commission announced that, as of January, CB would be expanded to 40 channels. In fact, the radio I purchased from one of the local department stores cost me under sixty dollars including slide-in lock mount and antenna with trunk lip mount and coax. I saw it advertised on TV one evening and ran out to purchase one before they were all gone. As it was, I had to wait for the next shipment as the demand was so great. The line at the counter stretched to the door, and this was a chain department store with many such locations. It would not surprise me to learn that this sale alone added over ten or twenty thousand new operators to 11 meters.

Anyhow, after unpacking the radio, I hooked it up to my allband long wire to see if I could hear anything. Hear anything? It was probably 100 deep on every channel other than 9, which is reserved as an emergency channel. Yet, in some uncanny way, a way that I still find hard to understand, people were actually having conversations and enjoying themselves. Squeaks, squawks and heterodynes everywhere, yet QSOs were going on — people interacting with people — very informal and a lot of obvious friendship. Everyone had a "handle," a pseudonym for personal identity, but what was surprising was that all but a few were using callsigns. When someone didn't use his legal callsign, he or she was "jumped upon" by many others. Hmmmmm . . . could it be that CB was changing? Could it be that average "Joe American" was now taking CB over from the hobbyist DXer and that, handles aside, CB was finally growing into what it was intended from its inception? Let's listen a while longer. An actual language barrier existed. I was finding it hard to understand a lot of what was being said; CB has its own "special language" much the same way that amateur radio has. Since I always believe that one should listen before engaging a PTT button, I took my own advice, sat back and garnered the necessary education.

Over the weekend I installed the locking slide mount and antenna on my '66 Galaxie, which in itself was no easy task, this being my favorite of our two autos even though it's older. I already had two such mounts for the two and 220 transceivers, a Motorola control head and a tone-pad to work around. Luckily, the CB radio was small and fit well just above the gas pedal . . . on the dashboard, that is, between the two meter radio and the Motorola speaker. A vacant spot was found on the rear fender of the driver's side and the lip mount discarded in favor of the regular 3/8" snap-in blind mount and adapter for the ASP type thread. Tuning the antenna took about 15 seconds using a Heath VSWR bridge to make the check that found the approximate midband VSWR at 1.2 to 1 and rising to 1.6 to 1 at either end (channels 1 and 23 respectively).

Can't tell you how strange I felt during my first 11 meter contact. It took a while to get used to the lack of formality, besides which I had no handle other than my name and callsign KKU4645. The strange feeling was short-lived though. By and large, the people one finds on CB are like the neighbors next door. Heck, in many cases, they *are* the neighbors next door. With few exceptions, the people I have met on CB have gone out of their way to make me feel at home with them. At first I kept my interest in amateur radio low profile . . . just being one of the guys . . . one of the voices on the radio. This didn't last. I became involved in many a contact with CBers talking about "moving up" (no pun intended) to amateur radio with specific interest in two meters and FM repeater operation. You have no idea of the impression it makes on a radio-oriented non-amateur to hear a demonstration of the coverage of a good FM repeater. Eyes light up . . . I have seen it happen! So far, the CBers I have met out here in LA who want to get their amateur licenses have no interest in CW, and cannot understand the need for it when all they want to do is talk. Many would be hams right now if not for that obstacle.

Left to right: Johnny Grant WB6MJV, host of KTLA-TV's "Gallery" show, Lee Goldberg WA6AVP, Mary Stocksdale WA6LUC. (Photo by Bob Goldberg WB6OFO)

NOW OPEN
AMATEUR RADIO
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Two ways to let the world know who you are. Left: in red, white and blue from SANDARC, San Diego. Center: from LIMARC, New York. Auto: '66 Ford from WA6ITF; 2m antenna from GAM.

So far, in the few weeks that I have spent meeting the members of our local Citizens Radio community, I have been quite impressed by the dedication of many of them. Sure, they have their problems — jamming, malicious interference and, unfortunately, a bit of profanity on the part of a few "channel hogs." Basically, they suffer many of the same problems we face in amateur radio, only down on 11 meters the problems are greater due to the greater number of radios in use, the greater number of users of the spectrum, and therefore the chance for a greater number of "flaky" people to be part of the service. Simple math . . . the more individuals, the more chance for problems to show up. Interestingly, though, it seems that self-policing is starting to develop within the service, at least where I live; those who break the rules of CB etiquette are dealt with by their peers.

As things develop, and as I gather more information, I will pass it along. However, I am convinced that CB radio and its users are the best resource we have to tap for the growth of the amateur service. Many, not all, but many, CBers would like to get an amateur ticket if only amateurs would get off their "high horse" and offer a needed helping hand to those asking for it. It hurts when I hear about CB people going to local hams for assistance in that direction only to be met with a look of indignation and "get lost, who needs you" attitude. Put yourself in the other guy's place . . . how would you feel?

Oh yes, my lack of handle was also short-lived. While checking out the CB radio, I enlisted the aid of a fellow amateur, Charlie WB6SKM, who also possesses a CB radio. Charlie promptly christened me "The *73* Man" . . . well, what else?

While getting a CB radio as I did and taking amateur radio to the CBer was one way, there are other ways of getting the interested CBer to take the next step. A recent, well-publicized event here in Los Angeles was another way. Take an excellent producer-director team like Lenore (W6NAZ) and Bob (W6VGQ) Jensen. Add a well-known and talented emcee such as KTLA-TV personality Johnny Grant WB6MJV, an expert audio engineer like Bill Orenstein KH6IAF/6 with extremely fine equipment, and a bit of help from KHJ radio's Jim Davis WB0SQP/6 to set up and handle audio. Continue with an introduction using Dave Bell's new film, "Moving Up To Amateur Radio," which in itself has the ability to captivate an audience. Include a number of experts on different aspects of amateur radio

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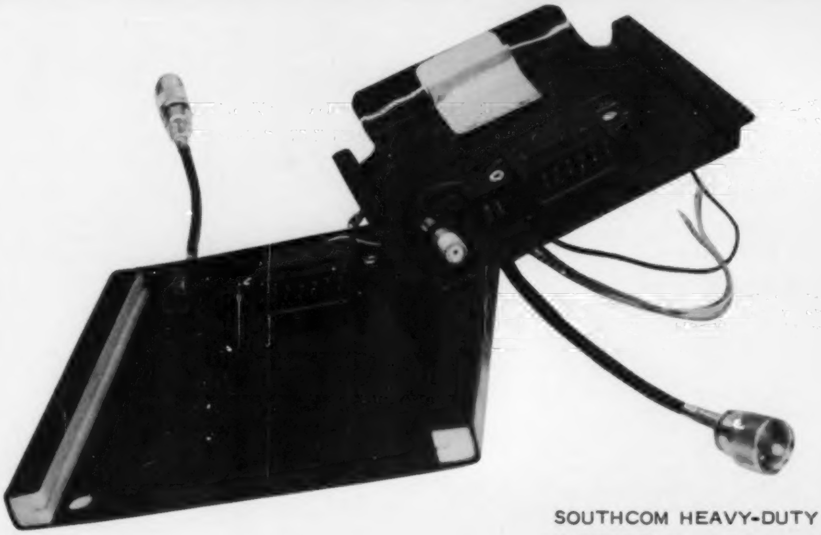

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The Largest FCC Raid Ever

Federal marshals and FCC agents raided 19 locations in the Baltimore-Washington area early on the morning of October 27. Confiscated was over 65 thousand dollars worth of equipment used by outlaw SSB CBers. (See "In Pursuit of the HFers," Holiday '76 *73*.) It was the largest single raid in FCC history and capped a lengthy investigation by the Baltimore office in conjunction with the Laurel MD monitoring station. Similar investigations are ongoing across the country, according to FCC sources.

Among those charged with illegal operations were two Novice class amateurs and an alleged ringleader of Maryland CB SSBers. The agents, armed with search and seizure warrants, confiscated extensive membership lists giving call numbers and full names and addresses of the entire Maryland chapter. An FCC spokesman told *73* he expected some further investigations to grow from the lucky find. Station records taken in the raids are being scrutinized in an effort to identify every individual who may be involved and where equipment was purchased.

As illustrated by the accompanying photographs, amateur equipment made up the bulk of the FCC raids. Confiscated were a half dozen linear amplifiers, Heath and Yaesu transceivers, frequency counters, remote vfos, VHF HTs, beams and rotors, along with several ingenious CB rigs. One unit was reportedly set up like an ordinary CB rig with a frequency counter slung underneath. But when you switched on the ANL, the counter would indicate frequencies between 10 and 11 meters, and the delta tune became a vfo!

The FCC in Baltimore is conducting an inventory of all the equipment and taking technical measurements to determine exact frequency range and output. Serial numbers are being checked through local authorities to determine if any of the gear was stolen. (Amateurs in the Baltimore-Washington area who are missing gear would be wise to contact FCC Baltimore.)

All 19 CBers raided face federal charges carrying penalties of $500 dollars per day, per offense, and one year in prison and a $10,000 fine for the unlicensed use of CB or amateur radio equipment. Federal judges will decide what happens to all that equipment; it could go towards fines, be declared contraband, or end up on a government surplus list. In any case, it seems likely some of the equipment could go to charitable organizations, and show up on 20 meter SSB in the hands of a missonary, handling phone patches.

Incidentally, it was not the work of hams that led the FCC to the outlaws . . . instead it was the old Tennessee Valley Indians, plus what one FCC official termed massive interference to business radio, and local, state and Federal government radio users. Those are the same tracks that have led FCC teams to SSB outlaws in other parts of the country . . . and the same tracks that are being followed somewhere else as you read this, where would-be hams are taking the easy way onto the air.

Warren Elly WA1GUD
Associate Editor

A room full of confiscated equipment. Robert Mroz, Engineer in Charge, FCC Baltimore (left), and Assistant Engineer in Charge Donald Bogert (right), in the midst of their cache.

Some of the gear undergoing testing; note power output of 80 Watts and frequency of 27.9099 MHz.

Some of the modified CB gear confiscated in Baltimore-Washington. Note the external switching arrangements which allow out-of-band operation.

Dead Within A Decade?

Part 97 of the FCC Rules and Regulations has been changed so much in recent years that most amateurs are not completely familiar with existing requirements. Even those of us who teach licensing courses have trouble keeping up to date with the latest changes. It is my opinion that very few of the recent changes will benefit amateur radio and that many of them will harm our service. Simply stated, I do not believe amateur radio is strengthened by weakening the rules and regulations under which we function.

It has long been obvious to most of us that the FCC does not intend to clean up the mess they have allowed to develop on the old 11 meter band. It appears to me that the FCC is hoping to alleviate some of the present CB problem by easing as many CB people as possible into amateur radio.

I believe our ARRL has been duped into helping the FCC clean up part of the CB mess. I can understand the League supporting a program to produce more amateurs; this is reasonable. However, I find it very difficult to believe that our League cannot see the danger to our amateur radio service. Listen to CB and make up your own mind how "beneficial" these people will be to amateur radio.

I have taught amateur licensing courses every year since 1948. I have had as many as 1,000 students at a time. I have had an increasing percentage of CB people in my courses since 1957 and the current percentage is usually about 30%. It has always been my experience that students with CB background are the least likely to stick it out and earn an amateur license; their dropout rate is about double over the rest of the group. Fortunately, we have had many ex-CB operators develop into extremely good amateurs who are a credit to the amateur radio service. Unfortunately, most of them have been unable or unwilling to shake their bad CB habits and this is bad for amateur radio. It has also been my observation that very few CB people are seriously interested in becoming amateur radio operators. The objectives, backgrounds, and philosophies of amateur radio and CB are radically different.

I do not believe we need to greatly increase the American amateur radio population to safeguard our frequencies at the 1979 World Administrative Radio Conference (WARC). Amateur radio has realized its most significant gains at times when we had very few amateurs. To the best of my knowledge, all WARC position papers were required to be submitted in mid 1976, so any upsurge in the American amateur population (between mid 1976 and the 1979 WARC) will not appear in those papers. Common sense further discredits the present "safety in numbers" approach. Basically, each country has an equal voice at WARC. This means that a country with hundreds of thousands of amateurs has the same voting strength as one with only a handful of amateurs. Since our country has one of the largest amateur populations in the world, it appears reasonable to me that the major objective should be to increase the numbers of amateurs in other countries. Our voting power at WARC will not increase one iota if we double or triple the number of amateurs in our country; please don't be gullible enough to believe otherwise.

My thoughts on this matter are summarized in this paragraph and I hope you will take the time to arrive at your own decision. I am opposed to recent FCC changes which I believe will seriously degrade our amateur radio service. I believe that FCC deregulation of amateur radio can lead to disaster. I do not believe the CB mess will be significantly reduced even if many of them are absorbed into amateur radio. I think the CB mess must be dealt with on its own by the FCC and that Congress should fund the FCC to do this major job. I am firmly convinced that converting any significant number of CB people to amateur radio will degrade our amateur radio service. I do not believe that a large influx of new amateurs is necessarily beneficial to amateur radio; it certainly cannot replace continuing quality performance of existing amateurs serving the public need.

If the present trends continue, I have no doubt that the amateur radio service (as we presently know it) will be dead within a decade. I hope this does not happen because I believe the amateur radio service is of great value to all the peoples of the world. If I did not believe this, I would not spend 20-30 hours per week helping new amateurs get started.

If you decide that our amateur radio service is in danger, please take action to eliminate the problems. I believe it helps to send ideas to the FCC, Senators, Representatives, House/Senate Communication Subcommittees, ITU/IARU, and ARRL. I have been writing for years and I would greatly appreciate some support. I do not believe it is too late to save our American amateur radio service, but it appears obvious to me that it will die if most amateurs fail to wake up and take action. We are communicators; let's pass the word before it is too late!!

Bob Welsh W6ODB
Burbank CA

Reprinted from the LERC Amateur Radio Club Bulletin, *November '76.*

Is There Life On Mars?

A special event call is issued by the Federal Communications Commission to commemorate some particular event or activity. N6V was such a call, issued on the occasion of the Viking mission to Mars. The significance of the Viking mission (to softland a spacecraft on another planet) warranted an equally significant callsign. N6V was the first modern day 1 x 1 call issued by the FCC to an amateur radio station. The Jet Propulsion Laboratory Amateur Radio Club, W6VIO, is proud to be its owner. We owe many thanks to the Commission for honoring our request.

N6V is the third in a line of commemorative calls issued to the JPL Amateur Radio Club. WP6JPL was for the Apollo 16 mission, and WS6MVM was for the Mariner Venus Mercury mission (Mariner 10). Over the period from June to November, 1976, N6V became one of the most significant special events ever to be undertaken by a single group of amateurs. The operation united our club more than ever before because a real team effort was required in order to build a completely new station from scratch, and then operate N6V over a five month period.

When the JPL Radio Club undertook this activity, we anticipated an event of a size comparable to our previous special events, 2000 to 3000 contacts. It soon became apparent that we had a tiger by the tail, and would have to work 10,000 or more stations to satisfy the tiger's hunger. Our existing station would not be able to handle the load because of small quarters, high electrical noise, limited antenna possibilities, and poor location (in a canyon two miles north of the Pasadena Rose Bowl). The club's long-term goal of a new trailer facility in a better location was now given a deadline for completion . . . June 18, 1976, the planned first day for N6V, which coincided with the orbit insertion rocket motor burn (45 minutes worth) for Viking I. Dick K6SVP was assigned as facility manager. The time was now March.

Final site plans were drawn and submitted by Glenn K6GHJ to the laboratory facility engineering people in May for approval, a surplus tower was obtained from the newly formed Goldstone Radio Club, WB6MXU, surplus RG254 hardline coax (7/8 inch diameter) was found in storage, a TH6DXX 6 element beam and Ham II rotor were purchased, and the race was on. Mr. Murphy reared his head by having the first spool of RG254 coax delivered Friday afternoon to the trailer location at the *bottom* of the rough, brush-covered, rattlesnake-infested hill on which the antennas were to be located some 650 feet up from the trailer. The work party, including five of the JPL Explorer Scouts working on the lab sponsored Project Sunfire for Pitcairn Island, was already scheduled for Saturday morning. There was no time to transport the spool of coax (which weighed several hundred pounds and was five feet in diameter) to the top of the hill, so we gallantly began pulling the coax *up* the hill. Without a doubt, 650 feet of RG254 gets very heavy, especially in the hot sun. The next run of hardline waited until the spool was transported to the top of the hill so we could pull the coax *down*. A second spool of coax was obtained in July and two additional runs of hardline were added. All went smoothly this time, until the wooden spool holding the coax disintegrated on the spool stands. The only solution was to unroll the entire spool by removing all the remaining spool wood and carefully unrolling the entire 1700 feet of coax along the ground. We could then pull the line down the hill.

Tower installation began six days before the deadline. Again, Murphy! Would you believe that when we met the fellow supplying our guy wires

Roy Neal K6DUE oversees NBC "Today" show filming.

KABC newsman interviewing Jim Lumsden WA6MYG.

All N6V transmissions were not SSTV. Here Bob Brodkin WA6TBH works CW under the watchful eye of the Viking project's biology man insignia.

and crimp sleeves at the top of the hill, and he went to open the trunk of his car, Murphy made the key not work? No amount of banging or twisting would open that trunk. Finally, we discovered that two identical cars had been parked side by side down below and that he had put the supplies in the right car, but driven off in the wrong car with the right ignition key! That wasn't the last of Murphy. He decided that one of the tower guy anchors would have to be set in solid rock! By the time we finished we had placed on top of that hill, aside from the 71 foot tower and tribander, a 2 meter collinear, an inverted vee for 40 and 80, and a 40 through 10 meter vertical.

In spite of it all, N6V went on the air at 1300Z, June 18, 1976, for the first operating period of five days. The basic plan was to operate for a total of forty days, divided into four periods coinciding with the four major mission events: Viking I orbit insertion, Viking I landing, Viking II orbit insertion, and Viking II landing.

The first period of five days netted 2250 contacts toward the goal of 10,000 and gave us the confidence that N6V would achieve its goal. We were very pleased at this initial achievement, since the station was manned almost entirely during nonworking hours. Because we were a bit late getting the publicity out to some of the publications and missed the June issue, we were met with a bit of amazement and uncertainty as to the legitimacy of the call, but word spread pretty fast. Most worked modes were 20 CW, 20 SSB, and 2 FM, accounting for about 85% of the total contacts. The lowest count was 2 FM CW with one contact (what a surprise that contact was). Other bands and modes were worked, but seemed to be worked out pretty fast. Admittedly, our ears were not very good on 40 and 80 meters, mostly because those antennas for the first period were fed through 700 feet of RG9 coax with the consequent signal losses.

One of the biggest surprises while working 2 meters was being linked to the Kingman AZ 146.16/76 repeater some 600 miles away through a remote link on 146.52 simplex. Most of us were totally unaware that such a link existed. The next surprise was to hear that the entire link was controlled by Jerry WB6NQE while sitting on a diving board at Huntington Beach! Later connections into the remote link put us into locations like Las Vegas NV, El Paso TX, Santa Barbara CA and other points over the mountains north of us. Tremendous! Another highlight of two meters was to contact Bill Pickering, retired JPL Director and ex-Z2BL, while visiting the shack. He was put in contact with the giant Goldstone 64 meter (210 feet diameter) antenna control station console which was being manned by one of the Goldstone Radio Club members. The link to the High Desert was made possible through WR6ALH, Rosemend CA, and WR6AFX, Table Mountain CA.

The reception that N6V received on the repeaters was tremendous and much appreciated. In most cases, N6V operation on repeaters was minimized during commuting hours. Initially, we had only two simplex and four repeater crystals; however, we soon realized that proper coverage of 2 meters required a synthesizer, which the club quickly purchased. It was like adding a new band, because we could now work all repeaters that we could reach, as well as other simplex frequencies. The Ensenada Radio Club, XE2BC, met us on one of the now available frequencies on sked one evening and we worked most of the guys in the Ensenada Club.

Novice response was, at first, one of bewilderment and disbelief. A three character call? That just did not fit the pattern! Frequently, the return call after a CQ would be to WN6NBV (N6V end to end, almost). As word got around, things got easier and the response got better. Ralph WB6YMF put in many hours at the Novice key.

The most fortuitous station worked early in the event was Mel W6VLH, who asked if we would be on SSTV. Our answer was negative, that no one in our club had the equipment. A couple of days later, we received a call from Robot asking what equipment we needed for SSTV operation and if they could loan it to us! Thus began one of the most wanted SSTV operations in the world. Jim WA6MYJ and Stan K6YYQ operated most of the SSTV (since the equipment was on loan we were sensitive as to its use). Pictures of Mars from both the Viking Orbiter and Lander were aired over N6V, occasionally into areas where there was little or no news coverage of the mission. A most memorable QSO was: "N6V de CZ2O. What are those pictures you are sending? They look like the surface of Mars!" "CZ2O de N6V. That's what they are!" We felt good that the pictures were recognizable. We are grateful to the JPL Public Information Office for providing us with the high quality photographs for our transmissions. We also had a direct video feed to the shack which allowed us to monitor and transmit some of the photos "live" from Mars as they were received here on Earth and processed by the computers. Jose YV5FBL, Caracas, Venezuela, was late to a ham club meeting when the XYL said that the Mars pictures were more important. Besides, he said the rest of the club would not believe him unless he had tapes to prove it. At least one ham, Bill W1PFA, was able to have his Polaroid photo of our transmissions published in the local newspaper, and then sent us a clipping. Bruce VK3VF sent impressive photos of a couple of pictures he received and also submitted to the newspaper. VE3AXC arranged to have TV news coverage live while receiving SSTV. Our local KABC-TV news team covered our operation in the Los Angeles area. Bob WB0JGJ got a story in his local Des Moines IA paper, which was picked up by the AP wire service, and culminated in many local TV news stories filmed in individual local towns (we haven't received all the video tapes yet) and also in a 5 minute report by Roy Neal K6DUE on the NBC "Today" show. As far as we could ascertain, that was the first time a film had been made from both ends of a QSO at the same time. That Roy's always thinking, but what a problem! We had to pick a station in one of several major cities in the US, establish a schedule with him, guarantee a contact at 8:00 am our time, all in less than 24 hours, so that Roy could schedule film crews in separate cities for the following day. Frank WB5SAG was our choice, and the filming was *1000%* successful. We're not sure who was flying higher — Frank or his patients (Frank is an anesthesiologist in Houston TX).

One contact, KC4AAB/M Reg 2 off the coast of South America, expressed more than the usual interest in the Viking mission progress during one of the SSTV operating periods. It turned out that the ship was an icebreaker on its way back from Antarctica with

The famous Mars ledge with a B or number 8 as it appeared from the Viking lander's camera prior to SSTV transmission.

The selection of hard copy pictures for SSTV transmission . . . here, Stan Brokl K6YYQ works near a picture coming from Mars.

several Viking project biologists on board. They had heard no news of Viking's success and were most appreciative of the information heard and vowed that before the next trip out they would have SSTV on board.

The station at N6V was not yet equipped for working OSCAR, so Skip W6PAJ came to the rescue with his mobile setup for working the satellites. Murphy caused an aluminum plate in the roadway to tilt and lodge under his van chassis as he drove by, literally launching all the equipment from the seats onto the floor. Remarkably, all equipment worked afterward. The only other problem encountered while working OSCAR was the high received noise level so that many stations returning Skip's CQ could not be heard. Several stations did get through, however, and we were very pleased that Skip braved the hill to set up on the mesa above JPL a few feet from the rattlesnakes (they *were* heard).

QRP was occasionally exercised, with George K6YGN braving the QRM most of the time. A 5/9 signal from Hawaii on 2½ Watts and 5/8 from the east coast on 1 Watt are not bad reports.

QSLing finally got underway about a month late when we received the cards from the printer (not entirely his fault) and we began filling the SASEs (first as promised). The hardest QSLs to deal with were those that included the SASE and a note saying, "Please send me the QSL card for contacting N6V." No time, date, band, or callsign! At the time we received that card, we had over 6000 entries in the logbook. Another QSL was a bit better; he at least included his callsign. Because we hope to QSL 100%, they will both receive their cards, just a bit later than hoped for. We received cards from several SWLers, and even one from an experimenter who copied SSTV. "Please QSL to W6VIO, Whiskey Six Viking In Orbit" became a catch phrase.

The effort involved in conducting an event the size of N6V is more than significant; it is major, as Jim WA6MYG found out. When volunteering to head the activity one year ago, the magnitude of N6V was not even dreamed of. Although painful (literally) at times to many who participated, the event was very successful, very satisfying, and enabled the JPLARC to realize one of its long term goals . . . a new station. Many friends were made both within and outside the club. This event will be remembered as a unique experience for many years.

Did it seem like a clique running N6V? All who came and participated became a part of the "clique." The list below cannot possibly cover all contributions of every individual; N6V was a team effort and everyone helped in many areas: Jim Lumsden WA6MYJ, N6V Activity Chairman; Dick Piety K6SVP, Facility Manager & Operator; Stan Brokl K6YYQ, Facility & Operator; Ralph West WB6YMF, Facility & Operator; Chuck Weir W6UM, Equipment & Operator; Norm Chalfin K6PGX, Photographer & Operator; Merril Burnett K6BER, QSL Manager; Glenn Berry K6GHJ, Facility; George Williamson K6YGN, Operator, QRP; Jack Patzold KDT6574, Facility & Operator; Warren Dowler KNX8341, Operator; Skip Reyman W6PAJ, OSCAR, Gordon Crawford WB6DRH, Publicity; Jim Longthorn WA6KPW, Operator; Rich Ward WA6VOG, Operator; Merv MacMedan W6IUV, Operator; Bob Brodkin WA6TBH, Operator; Bob Biswell W6MZR, Operator; Stan Sanders WB6MPM, Operator; Joe Berry WA6FCE, Operator; Stan Hench WB6JMP, QSL Design; Bill Carpenter WA6QZY, Video Feed; Waldo Brown W6QWC, Video Feed; Jay Holladay W6EJJ, Trustee.

Beating the Hamburglar

If crime statistics prove correct, nearly all of us can expect to have that prized mobile rig forcibly removed sometime in the near future. It can happen in a parking lot, your own driveway, the service station, or right outside on club meeting night.

The best way to be sure that you don't become a victim of Midnight Electronics Supply is to remove the rig and all markings that indicate the presence of radio equipment. This may also include the extremely unpalatable task of returning those callsign plates to your local registry.

The dyed-in-the-wool mobile operator realizes that no matter how many precautions are taken, it's often next to impossible to completely hide the fact that gear is contained within. So here are a few dos and don'ts for hams that just might keep the cost of the hobby within reasonable bounds.

Do keep your bill of sale in a safe place at home, not in the car.

Do engrave your driver's license number and state on both the inside and outside of the rig.

Do install a quick disconnect system. When leaving the car, take the rig with you or place it in the trunk. Out of sight, out of mind.

Do make sure that you have adequate insurance coverage for your gear. The insurance situation is worth an article by itself. Remember that even though you have homeowners or comprehensive auto theft coverage, there may be exclusions on radio gear as well as high deductible and depreciation clauses.

Don't try to hide the rig with a jacket or blanket. It only arouses curiosity.

Don't leave the car unlocked. Although it sounds like a silly statement, the vast majority of ripoffs happen through the car being inadvertently or purposely left unlocked. Most insurance companies won't pay claims unless there is proof of forced entry.

Don't try to booby-trap your gear. Not only is there a chance that you or a loved one might be injured, but you face the possibility of a lawsuit for assault. (Don't laugh, it really does happen.) For example, if a kid sees your booby-trapped 2 meter rig and goes for it thinking it's CB, WHAMMO! His family can nail you under laws governing what's called an "attractive nuisance." Juries are known to be sympathetic to the kid in these cases and you could be out a few years' pay in one fell swoop.

If, despite the above precautions, you still become victim of the ripoff, here are a few steps to follow:

1. Make sure you really suffered a loss. The gear could be sitting back on the kitchen table or hidden away in the shack. This can be *extremely* embarrassing.
2. Call the local police. Tell them what happened, what was taken, and the identification markings on it. If an item marked with your driver's license

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Looking *West*

from page 10

OSCAR. Give all this enough prepublicity and you have the makings of an entertaining evening to present to the general public and particularly the Citizens Service operators of the area. This was exactly what was done the evening of September 15, 1976, when the San Fernando Valley Radio Club, in cooperation with the ARRL, sponsored the first "Wide Wonderful World of Amateur Radio" evening subtitled "Everything you always wanted to know about amateur radio but were afraid to ask."

Johnny was at his best that evening, keeping things moving right along, while at the same time being truly entertaining. It was obvious that for him the evening was a labor of love. The pitch of the program was kept high, moving from topic to topic, explaining in progression the many diverse aspects of amateur radio and the people therein. There were demonstrations of slow scan TV, repeaters and autopatch, talks on RTTY and public service. In all, the entire gamut of what amateur radio is all about was covered in this fast-paced two hour presentation. It took a lot of planning, a lot of giving on the part of those involved and, most of all, a feeling on the part of all that what was being done would indeed benefit amateur radio. In the end, somewhere between two and three hundred local residents, many of them CBers, got a bit of insight into the world of the radio amateur and what an amateur could do within the scope of his interest. In all, it was an evening that epitomized the real amateur radio and on a fairly large scale shared it with the non-amateur.

If I had to pick one moment of that evening to call a highlight, I suspect it would be the story told by Lee Goldberg WA6AVP explaining how, for her, amateur radio was the therapy needed to aid in recovery from a serious illness. She told how, in the process, she went from non-amateur to Advanced class in a very short time span. These were moments that held everyone spellbound. Lee's story is one of beauty and dedication, and is an inspiration to set one's sights toward higher goals. Working hand in hand with her husband Bob WB6OFO, Lee not only conquered the after-effects of a serious stroke, but in the process has come to symbolize the important part that amateur radio can play in avenues never explored. Lee is not only a credit to her own personal initiative to conquer an obstacle put in her path, but is also an opener of new horizons for others to seek. She has given a very special new meaning to amateur radio.

If you have been thinking about trying such an event, but have feared that it might fail, fear not! This first was indeed a success and hopefully more such evenings will follow with other members of the amateur community emulating what was begun one warm September evening in Los Angeles. The first "Wide Wonderful World of Amateur Radio" evening will long be remembered by all who attended. Who knows, it may even get us a few new amateurs, and that would be the crowning glory. Yes, we were lucky to have a talented professional crew to start off this type of event, but it's nothing that any amateur radio club cannot emulate on either a larger or smaller scale, with or without the professionals. All it really takes is caring a bit as to whether there will be any amateur radio after the 1979 WARC Geneva conference. Those within our amateur community will pick up the ball and carry it. Is that someone you?

A REPEATER FOR ALL SEASONS

We have repeaters dedicated to many diverse aspects of our hobby/service. There are emergency calling systems dedicated to RACES and AREC type operation, autopatch systems whose prime purpose in life seems to be letting the XYL know that you are pulling into the driveway, club repeaters that, open or closed, are intended to act as an intercom between members of a given radio club and, lest we forget, the good old standby, the simple rag chew type of open system available day and night for anyone to use as long as they operate within the scope of their license privilege. Did I say anyone? Pardon my blunder. Well, though many a system professes to be open to all, in many cases one group does not always get a warm welcome. What group? Why, the "youngster," of course. You know, that group still in school, ages 15 or so and younger, who happen to hold amateur licenses but find it quite hard to develop the same type of lasting friendships on repeater systems that we in the next generation up seem to take for granted.

The beautiful story of amateur radio as a therapeutic tool described by the person who used it as such — Lee Goldberg WA6AVP, with OM Bob WB6OFO.

Admittedly, there is an interest difference between the generations, but must there also be a different set of standards imposed on the younger ham? Must they be relegated to 40 CW when they too have a need, and indeed, by the fact that they have passed the same test as you and I, a *right* to share the same spectrum? And that includes repeaters! At long last someone is about to put into operation a repeater system that will have one specific purpose for its existence: to give the younger generation of amateur with an interest in VHF and repeaters a place to converse with his peers. In a nutshell, that's the avowed prime purpose of WR6AKG and its father, Keith Glispie WA6TFD.

Keith, not that long out of school himself, noted that while virtually every special interest group had a repeater and a format upon which to interact, the younger generation of amateurs in Los Angeles had no such forum. As Keith tells me, about a year or so ago the whole idea began to take shape. Why not a repeater for this group? More specifically, why not a repeater that was designed to serve the need for school amateur radio clubs all over Los Angeles and surrounding environs, as well as their individual members? What a showplace to use as a tool to convince the public school CB operator that a whole new world exists in amateur radio. Not long ago, when the callsign WR6AKG arrived in the mail and a Pye Communications FM-50 high band repeater became available. Keith's dream began to become more of a reality.

As word of Keith's plan began to leak out, it began to have a rather positive effect on many members of the local FM community, including SCRA's Bob Thornberg WB6JPI, who quickly assigned Jim Hendershot WA6VQP of the Technical Committee to handle the coordination for this system and at least try to expedite the matter. With virtually every two meter channel now coordinated and in use, finding a channel for this project would not be easy, but it is not an impossible task. In fact, since it might be of interest to readers, we will be following the SCRA coordination of WR6AKG starting in this issue to show you exactly how the SCRA operates — sort of two stories in one.

About four weeks ago, after making the decision to put up WR6AKG, Keith contacted the SCRA and told them briefly of his intent. By return mail, he received an "RFC" (Request For Coordination) form that he filled out and returned to the SCRA. Normally, such a request would be placed before a meeting of the Technical Committee for action, but in this case certain parameters of the proposed repeater system called for special consideration on the part of the SCRA. Therefore, Bob directed Jim to look at all aspects of the matter, consider the parameters under which the system as proposed will operate, compare this with the environmental impact that such a system will have on any co- or adjacent channel users, and from this make a recommendation to the Technical Committee as to where on two meters to put WR6AKG.

Very shortly, Jim will have to report back to Bob and the rest of the Two Meter Technical Committee (SCRA has a separate 220 Technical Committee). If they agree with Jim's findings, then Keith will be issued a 90 day "Test Sanction," during which he will place WR6AKG on the air. While it's in operation, he will work with his adjacent channel users, co-channel users, if any, and the SCRA Technical Committee to solve any and all problems that might arise due to this system's establishment. During this time, Keith, like any other test sanctionee, will be obliged to file written reports with the SCRA Two Meter Technical Committee; any co-channel or adjacent channel users will also be given a chance to file any information they feel pertinent about the effects that the new repeater is having on their already existing system. From this myriad of information, the SCRA will make a final decision as to whether AKG will remain where now sanctioned permanently, be moved to a new assignment or perhaps moved to 220, or should no possible final "home" be possible, be requested to cease operation. As this all progresses, we will keep you informed. This, though, is what good competent technical frequency coordination is all about. Not just finding an "open slot" in which to put another system, but rather taking into account all aspects of the proposed new system, its effect on already established systems, the effects of surrounding terrain, the effect that the users of any new system will have on existing systems adjacent to it, and many other parameters that could fill an entire column. These are just a few of the items that Jim is currently investigating in his attempt to find a home on two for WR6AKG. How successful will Jim be? We will continue this next month.

Finally, a few comments of my own about the past two columns

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CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

ARRL VHF SWEEPSTAKES

Starts: 1400 Your Local Time
Saturday, January 1
Ends: 2400 Your Local Time
Sunday, January 2

Complete rules for the 29th VHF Sweepstakes can be found in the December issue of *QST* (please check for any last minute changes in the rules). Briefly, the rules are as follows:

All amateurs operating on or above 50 MHz are invited to participate. Contacts between stations in different time zones can be counted only when the contest period is in progress in both zones. Foreign stations may only work stations in ARRL sections. Crossband work and retransmitted signals (repeaters) are not allowed. Contacts with aircraft mobiles cannot count for section multipliers.

EXCHANGE:

QSO number, precedence (A = less than 50 Watts input power), your call, CK = last 2 digits of year first licensed, ARRL section or country.

SCORING:

Score one point for each exchange sent and each received (max. 2 points per QSO). Each section counts as a multiplier only once regardless of band and no more than one foreign country may be claimed as a section multiplier. Yukon-NWT counts as a separate multiplier. Final score is the total number of QSO points times the total number of sections plus 10.

LOGS:

Official logs may be obtained from ARRL. Send contest logs and summary sheet to: ARRL, 225 Main Street, Newington CT 06111.

QRP – WINTER – CONTEST

Starts: 1500 GMT
Saturday, January 15
Ends: 1500 GMT
Sunday, January 16

The contest is organized by the DL Activity Group – CW. Work 15 hours maximum during the 24 hour contest period, with no more than two pause periods. Select up to 5 bands from 160 to 10 meters. General call is "CQ QRP TEST." A station is not handicapped if CO/VXO control *and* VFO control are used on the same band or the input power of a commercial rig is reduced to below 2.5 Watts. QRO stations – same rules, but work only QRP stations and sign as ". . ./QRO"; scoring is the same.

EXCHANGE:

RST, QSO number, and input (1 to 9). Add "x" if transmitter is CO or VXO-controlled. Example: 579 005/8x.

SCORING:

QSOs with all stations are valid unless running QRO; then only QSOs with QRP stations count. Contacts with your own country count 1 point, own continent = 2 points, DX = 3 points, and score 3 additional points for a QSO with another QRP station (4-6 points). Score additional handicaps as follows: 1 handicap point for each station using below 3.5 Watts input or crystal controlled transmitter. Maximum handicap is 4 for any QSO. Both stations multiply QSO points times the handicap points plus one (QSO points x 5 maximum) to find total QSO points for that contact. Multipliers are as follows: own continent = 1, DX = 2 points per band and country according to the latest DXCC list, but call areas in JA, PY, VE, VK, W and ZS count extra. Final score is total QSO points (including handicap points) times the total multiplier.

LOGS:

Send entry including a "mini-log" to: Hartmut Weber DJ7ST, D-3201 Holle, Kleine Ohe 5, Fed. Rep. of Germany. Logs should be sent no later than February 15, 1977.

CLASSIC RADIO EXCHANGE

Starts: 1800 GMT
Sunday, January 30
Ends: 0100 GMT Monday,
January 31

Formerly "Nostalgia Radio Exchange," the contest is sponsored by the Southeast Amateur Radio Club, K8EMY, and is open to all. A classic radio is any equipment built since 1945 but at least 10 years old, an advantage but not a requirement in the Exchange. Object is to restore, operate, and enjoy older equipment with like-minded hams. General call is "CQ CX" on CW and "CQ Exchange" on phone; no AM phone below 21 MHz. The same station may be worked on each mode on each band.

EXCHANGE:

Name, RST, state, province or country, transmitter type (send PA tube if home brew, i.e., "6L6"), and any other interesting pleasantries.

FREQUENCIES:

CW – up 60 kHz from low ends.

Phone – 3910, 7280, 14280, 21380, 28580.

Novice – 3720, 7120, 21120, 28120.

SCORING:

Add the numbers of different transmitters, states/provinces/countries for each band. Multiply by total number of QSOs and then multiply that total by Classic Multiplier: total years old of your transmitter and receiver (if transceiver, multiply years by 2). Different equipment combinations may be used; figure scores separately for each and combine for total score.

ENTRIES:

Send logs, comments, pictures, etc., to: Stu Stephens W8KAJ, 2386 Queenston Rd., Cleveland Heights OH 44118. Certificates will be awarded for highest score, longest DX, most equipment combinations, oldest equipment, and "unusual achievements."

NEW HAMPSHIRE QSO PARTY

2000Z February 12 –
0500Z February 13
1400Z February 13 –
0200Z February 14

The New Hampshire QSO Party, sponsored by the Concord Brasspounders, Inc., W1OC, is held to promote the Worked New Hampshire Award. Operating periods are 2000Z Feb. 12 to 0500Z Feb. 13, and 1400Z Feb. 13 to 0200Z Feb. 14. Stations may be worked once per band per mode. New Hampshire stations may work each other. NH stations send RS(T) and county. Out-of-state stations send RS(T), ARRL section or country. NH stations score 1 point per QSO times the number of ARRL sections plus countries plus NH counties. Others score 5 points per NH QSO times the number of NH counties.

FREQUENCIES:

CW – 1810, 3555, 7055, 14055, 21055, 28130.

Phone – 1820, 3935, 3975, 7235, 14280, 21380, 28575.

Novice – 3730, 7130, 21130, 28130.

VHF – 50.115, 145.015, FM simplex (no repeaters).

AWARDS:

Top scorer in each NH county, and top scorer in each state, province, and country (50 points minimum). Additional certificate available for confirmation of all 10 NH counties. Send logs, summary and check sheets to: Concord Brasspounders, Inc., C. Halloway, 9 Via Tranquilla, Concord NH 03301. Mailing deadline is March 14, 1977. Include business size SASE for results and/or award.

QRP AMATEUR RADIO CLUB INTERNATIONAL INC. 1977 ANNUAL APRIL QSO PARTY

Starts: 2000 GMT Saturday,
April 2, 1977
Ends: 0200 GMT Monday,
April 4, 1977

This contest is open to all amateurs and all are eligible for the awards.

EXCHANGES:

Members: RST/RS. State/province/country, QRP number. Nonmember: RST/RS. State/province/country, power.

SCORING:

Stations can be worked once per band for QSO and multiplier credits. Each member QSO counts 3 points. Non-member QSO 2 points. Stations other than W/VE count as 4 points.

MULTIPLIERS:

More than 100 Watts input power – x1; 25-100 Watts input power – x1.5; 5-25 Watts input power – x2.0; 1-5 Watts input power – x3.0; less than 1 Watt power – x5.0.

Score equals QSO points x total number states/province/countries PEP band x power multiplier.

FREQUENCIES:

CW: 3540, 7040, 14065, 21040, 28040.

SSB: 3855, 7260, 14260, 28600.

Novice: 3720, 7120, 21120, 28040.

All freqs plus or minus 5 kHz or so to dodge QRM.

CALENDAR

Jan 1 - 2	**ARRL VHF Sweepstakes**
Jan 15 - 16	**QRP – Winter – Contest**
Jan 30 - 31	**Classic Radio Exchange**
Feb 5 - 6	**ARRL DX Contest – Phone**
Feb 5 - 13	**ARRL Novice Roundup**
Feb 19 - 20	**ARRL DX Contest – CW**
Feb 19 - 20	**YLRL YL-OM Contest – Phone**
Mar 5 - 6	**ARRL DX Contest – Phone**
Mar 5 - 6	**YLRL YL-OM Contest – CW**
Mar 19 - 20	**ARRL DX Contest – CW**
Mar 26 - 27	**CQ Worldwide WPX SSB Contest**
Apr 12 - 13	**YLRL DX-YL to Stateside YL Contest – CW**
Apr 26 - 27	**YLRL DX-YL to Stateside YL Contest – Phone**
July 2 - 3	**QRP – Summer – Contest**
Aug 20 - 21	**NJ QSO Party**

Note: ARRL contest dates are tentative, as they were not officially announced at the time of this writing (check *QST* for the exact dates).

Also, don't forget to send early for ARRL logs and entry applications for DX and Novice Roundup contests.

RESULTS

RESULTS OF 1976 NJ QSO PARTY

First Place Winners – NJ Counties		
Atlantic	WB2RJJ/2	660
Bergen	AB2RJJ/2	150
Burlington	WA2AWO	6847
Camden	WB2REI	6954
Cape May	AB2RJJ/2	325
Cumberland	WA2CZA	784
Essex	AB2RJJ/2	144
Gloucester	W2FBF	2886
Hudson	AB2JVN	17524
Hunterdon	W2TND	5436
Mercer	W2ZQ	31289
Middlesex	WA2NPP	62578
Monmouth	WA2WDT	546
Morris	WB2RKK	56508
Ocean	WB2FRH	2050
Passaic	AA2BSU	6594
Salem	AB2RJJ/2	240
Somerset	WA2WJY	24070
Sussex	W2FCL/2	6848
Union	W2EME	10865
Warren	WA2DUV/2	10950
Out of State Winners		
CT	WA1WEM	2898
NH	WA1YUK	1026
ME	WA1NKE/1	420
ENY	AC2WSS	168
NLI	WB2PYM	3444
WNY	W2NCI	940
MDC	WB2JYM/3	1617
EPA	K3UEI	3087
GA	AD4BAI	322
KY	W4KFB	88
NC	AC4OMW	1292
NFLA	WA4BTC	490
TENN	AB4WHE	494
VA	WA4JIY	900
WI	KP4EMN	144
LA	W5WG	1343
NM	WA5YTX	403
STEX	W5BWM	420
LA	WB6IOQ	325
ORG	K0GJD/6	896
SF	AC6ZT	1254
SV	AC6KYA	560
MI	WA8WWS	540
IL	WA9MGY	2014
IN	WA9ABI	20
WI	AB9NME	705
CO	AD0QIX	496
IA	W0PRY	1218
NE	W0EKB	48
MAR	VO1KE	322
ONT	VE3EJK	2160
DX	ZL2HE	4

METHOD OF CALLING:

Call: CQ CQ CQ QRP DE (callsign).

AWARDS:

Certificates to the highest scoring station in each state, province or country. Other places will be given depending on activity. One certificate for the station showing three "skip" contacts using the lowest power.

LOGS:

Send full log data, including your full name, address and bands used, plus equipment, antennas, and power used. Entrants desiring results please enclose a #10 SASE to receive result sheet. Logs must be received by May 30, 1977 to QUALIFY. Send all logs and data to: E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

THE MELVIN JONES 77 CONTEST

SPONSORSHIP:

The contest was instituted by Santos Lions Club Ponta da Praia. It will be supervised by the sub-directory of Labre of Santos and the CW Praiano Group. It will be held every year during the second weekend of January for CW and during the third weekend of the same month for SSB.

AIMS:

The contest intends to provide contact among the largest possible number of ham operators all over the world and to proportionate the International Interchange among Lion ham operators.

PERIOD:

CW section – Beginning Saturday 8-01-77 – 00:00 GMT = 21:00 hours Brazilia time 7-01-77, to Sunday 9-01-77 – 24:00 GMT = 21:00 hours Brazilia time 9-01-77.

SSB section – Beginning Saturday 15-01-77 – 00:00 = 21:00 hours Brazilia time to Sunday 16-01-77 – 24:00 GMT = 21:00 hours Brazilia time.

Single operator stations can only operate 30 hours out of the 48 hours of the contest. The minimum obligatory 18 hours of the QRT in the contest can be divided up into 4 periods at any moment during the course of the contest and must be clearly pointed out in the logs. The multi-operator stations may operate 48 hours.

BANDS:

The contest activity will be in the 3.5, 7, 14, 21 and 28 MHz bands.

COMPETITION TYPES:

a) Single operator, any band; b) Singe operator, just one band; c) Multi-operator, any band.

MESSAGES:

For Brazil, the CW bands will be constituted of the RST followed by the States abbreviation, and for foreign stations only RST. Example: PT 2 JB 559/DF – DJ 2 MN 599 – ZS 1 WA 599. CALL: CQ Contest Melvin Jones.

For Brazil, SSB will be constituted of the RS followed by the States abbreviation, and for foreign stations only RS. Example: PY 2 LB 59 GO – PY 2 BOR 59 SP – W 2 PV 59 – LU 1 BB 59. CALL: CQ Contest Melvin Jones.

POINTS:

a) QSOs with stations of different continents shall count 3 points in the bands at 14 and 2 MHz and 6 points in the 3.5, 7 and 28 MHz bands.

b) QSOs with stations in the same continent shall count 1 point in the band of 14 and 21 MHz and 2 points in the 3.5, 7 and 28 MHz bands.

c) Contacts between stations in the same continent are allowed but shall count only 1 point.

MULTIPLIERS:

All the Brazilian States and Territories and all countries worked will be counted only once; even if worked in different bands they will be multiplied by the total number points.

AWARDS:

a) The ham operator who attains the greatest number of points in the world on CW will be granted the International President Lions Club Trophy, and the one who gets the greatest number of points on SSB will be granted the District L-16 Governador Trophy together with special diploma for each mode: CW or SSB.

b) A trophy will be granted to all those who get the most points on each continent. To second place, we will give a medallion containing the Santos Ponta da Praia Lions Club inscription. Diplomas will be awarded for each mode of operation: CW or SSB.

c) The Brazilian ham operator who gets the greatest number of points on each mode will be granted the Santos Lions Club Ponta da Praia Trophy. The second place will be given the Lions Medallion.

d) The country which gets the greatest number of points among all participant countries will be granted permanent possession of the Melvin Jones Trophy.

DIPLOMAS:

a) Every ham operator classified in the first and second places in each country and also Brazilian States and Territories will be granted a special diploma mentioning the classification.

b) The other foreign and Brazilian ham operators taking part in the contest will receive a diploma of participation once they get a minimum of 500 points or 50 contacts.

c) All radio receivers from all over the world including the Brazilians who send their reports mentioning bilateral contacts will be granted special diplomas. For that a number of 25 contact reports is required.

REPORTS:

a) The time must be indicated in GMT (= Brazilian time plus 3 hours). The periods of 18 hours (minimum) of QRT must be clearly indicated in the log.

b) Use one log sheet for each band.

c) All the participants must attach to their log a QSL card addressed to Santos Lions Club Ponta da Praia.

d) A summary must be sent postmarked no later than 30 days after the contest. They must be sent to: Ham Operator Contest Commission, Santos Lions Club Ponta da Praia, P.O. Box 11, 11100 Santos SP Brazil.

DISQUALIFICATION:

Violation of the ham operator regulations, non-ethical conduct, QSOs in duplicate in the same band and non-participant prefix can cause a loss of points. The acts and decisions of the Contest Commission will be decisive.

INTERNATIONAL SHORT WAVE LEAGUE

If you work a fair amount of DX and try to QSL most, you may be interested in the International Short Wave League, 1 Grove Road, Lydney, Glos, GL15 5JE, England. Besides the monthly newsletter giving DX operating notes, contests, awards, etc., you also get full use of their two-way QSL bureau. Their bureau does not require SASEs and incoming QSLs are mailed at regular intervals. The membership fee for US hams is $10 per year. The ISWL also provides a translation service, a correspondence bureau and a large selection of awards:

Century Club – For confirmed 100 countries; stickers each additional 25.

Heard All Continents – Verified contact with 10 stations in each of the 6 continents.

Heard All States — Verified contact with 48 continental US states.

Commonwealth Award — Verified contact with 50 different countries within the British Commonwealth of Nations.

European Award — Verified contact with 50 different countries within continent of Europe.

Pacific Ocean Award — Verified contact with 45 different countries which have at least a part of their coastline on or in the Pacific Ocean.

Zone Award — For working 25, 50, and 75 ITU zones.

5 Band DX CC Award — For working 100 countries on 5 bands.

MARAC AWARDS

Any hams interested in county hunting or information on the Mobile Amateur Radio Awards Club (MARAC) should send a large SASE with 3 first class stamps to Bertha Eggert WA4BMC, P.O. Box 6811, Southboro Station, Lake Worth FL 33405. Or, try listening to one of the county hunter nets on 14337 (from 1300 GMT daily), 3943 (from 0100 GMT daily), 7237 occasionally, or the CW county hunter nets on Wednesday evenings 2300 GMT on 7055, Saturdays at 1400 and 2000 GMT on 14070, and Sundays at 1430 GMT on 7055. More information on CW county hunting can be obtained from K1ZFQ who publishes a monthly newsletter for $2.40 per year. The awards available from MARAC include:

Cliff Corne Jr. K9EAB Memorial Award — For working holders of the USA-CA All Counties Award; in classes of Basic = 10, C = 25, B = 50, A = 75, AA = 100. Basic award $1.00, seals for SASE.

Associate Award — For working charter, regular, or associate members of MARAC for a total of 100 points for the basic award with seals for 250, 500 and 1000 points. Regular members count 2 points each and associates count 1 point each. Fee: $1.00.

M-50-M Award — For working mobiles in all 50 states; original award for 48 states, seals for 49 and 50. Special seal for working all states mobile to mobile. Fee: $1.00.

YL Mobile Award — Work 5 or more YL mobiles in a total of 50 different counties. Seals for 100, 200, and 500 counties. Plaque for 1000. Fee: $1.00.

MARAC DX Mobile Award — For working 25 DX counties while operating mobile. Seals for 50 and 75 counties; plaque for 100. Fee: $1.00.

MARAC Last County Award — First category: Basic award for any station giving last county to finish a particular state. Seals for second, third, and fourth times. Same county and state may be given in each instance. Send application and mobile reply card signed by recipient stating facts for verification. Award can be repeated. Basic fee: $1.00. Second category: Basic award and plaque to any station giving last county to finish ALL states. Fee: $7.50.

Merit Award — Free to any amateur upon recommendation of any MARAC member for outstanding service to amateur radio.

Worked All Counties USA Second Time — For working all counties in the USA a second time!

MARAC Mobile Award — Category 1: To any mobile for giving out at least one county in each of 15 states; seals for 25, 35, and 45 states: plaques for 48, 49 or 50. Category 2: To any station for working the same mobile one time in 15 states; seals for 25, 35, and 45; plaques for 48, 49, and 50. Category 3: To any mobile for giving out 100 different counties; seals for 250, 500 and 1000; plaques for 1500, 2000, 2500, 3000, and 3075. Category 4: To any station for working same mobile in 100 different counties; seals for 250, 500, and 1000; plaques for 1500 2000, 2500, 3000, and 3075.

All award applications should be addressed to: MARAC Awards Chairman, 602 Jefferson St., Lee's Summit MO 64063. Further information can be obtained from WA4BMC as noted earlier.

NC COUNTY AWARD

Basic award $1.00; additional awards for SASE. Classes: D = 30; C = 54; B = 75; A = 100. Send GCR list of stations worked and confirmed to: Alamance Amateur Radio Club Inc., P.O. Box 503, Graham NC 27253.

JUMPING OFF PLACE AWARD

Honoring Independence MO Award; free of charge for working Independence MO stations for points. 5 points total needed. WB0AEW, WB0GYR and W0QWS count 2 points each; others are 1 point each. Apply to Jerry Dowell WB0GYR, 14412 37th St., Independence MO 64055. No date, time or mode limitations.

THE MAPLE LEAF AWARD

Available to both amateurs and SWLs, the award consists of 2 parts — a flag parchment diploma and a Canadian Maple Leaf Flag lapel pin. The award is for working (or hearing) and confirming Canadian amateur radio prefixes. QSLs must be in your possession. A GCR (certified list) must accompany your application. QSLs should not be sent unless requested. Classes: 1. 30 or more different Canadian prefixes; 2. 25 different Canadian prefixes; 3. 15 different Canadian prefixes.

A special plaque award will be issued free of charge to any radio amateur who works and confirms 50 or more different Canadian prefixes. All contacts for all classes must be made after January 1, 1965. Send application, GCR, and 10 IRCs or $1.50 (or equiv.) to the awards custodian: Mr. Garry V. Hammond, Geography Department, L.D.S.S., 155 Maitland Ave., S. Listowel, Ontario, Canada N4W 2M4.

Prefixes can come from: CF, CG, CH, CI, CY, CZ, VA, VB, VC, VD, VE, VF, VG, VO, VY, XJ, XK, XL, XM, XN, XO, 3B, 3C and any later ITU assigned callsigns.

CHN MOBILE ACHIEVEMENT AWARD

Issued in 3 different categories: 1. For working mobiles in counties of any one state; 2. For mobiles giving out counties of any one state; 3. For working same mobile in counties of any one state.

BONANZA — The applicant gets award for working same mobile and the mobile gets award free as gift of applicant for giving out counties to same station.

Classes: A = all counties of a state: B = 2/3; C = 1/3.

RESULTS

HOWDY DAY CONTEST WINNERS

WA6WZN	82	YLRL Member
LX1TL	61	NON-YLRL Member
W2GLB	78	
WA1UJV	75	
DJ1TE	74	
DJ1EIC	73	
K4RNS	59	
HB0ARC	59	
WB4PXN	57	
DK5TT	53	
DJ0EK	42	
WA4ORK	33	
DK2KD	30	
WB4FYU	29	
WB0JFF	27	
DF2KG	27	
WA2VIE	23	
PY1IFI	23	
F5RC	21	
PA0HIL	19	
WA2DMK	15	
WA2RXD	8	

For confirmation only — DL3LS and DK1HH

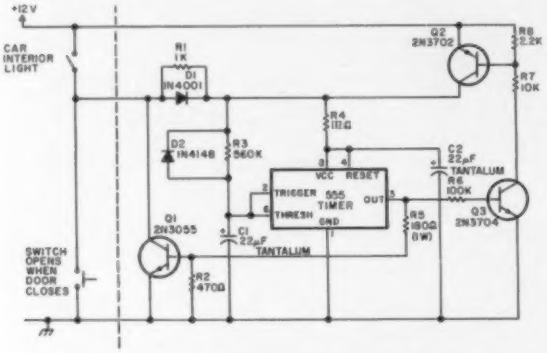
RESULTS

RESULTS OF 1976 PACC CONTEST

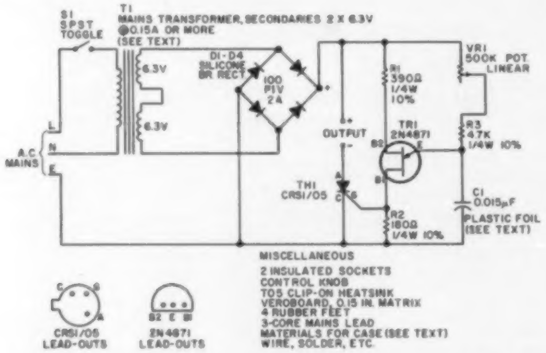
Top Country Winners, Single-Op	
DK8AX	2400
DM3NKF	7321
EA4BV	1440
EA8IR	957
F2VO	1176
G3VTT	2100
GI3JEX	3480
GM3MZV	6942
GW4DOO	1320
HA0IG	1620
HA5KHD	8670
HB9QA	1728
I3DUU	1710
JA6BSM	570
LZ2RF	10170
OE1TKW	720
OH6UW	1620
OK2BLG	9801
ON6NL	3417
OZ4LX	351
SM6EUZ	2646
SP3GCT	5670
UA3QAQ	11718
UA2FBI	5376
UA9JAA	2250
UB5ZBB	9996
UC2BA	1035
UJ8JAS	1836
UL7GAA	1221
UM8NNN	561
UO5AP	2880
UP2BAR	10080
UQ2GCN	9765
YO2QY	1710
YU3TJA	3300
ZS6CS	2223
9H4G	384
USA — Winners	
AC3ARK	351
AC1OPJ	150
WB5IAL	105

Circuits^2

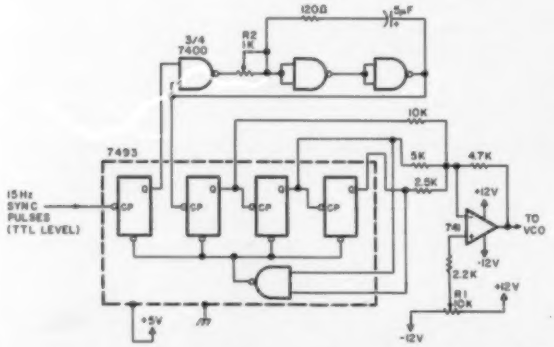
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice.


+12V
CAR INTERIOR LIGHT
R1 1K
D1 1N4001
Q2 2N3702
R8 2.2K
R7 10K
R4 11Ω
D2 1N4148
R3 560K
C2 22µF TANTALUM
R6 100K
8 VCC
4 RESET
2 TRIGGER
555 TIMER
OUT 3
6 THRESH
GND 1
Q3 2N3704
Q1 2N3055
C1 22µF TANTALUM
R5 180Ω (1W)
R2 470Ω
SWITCH OPENS WHEN DOOR CLOSES

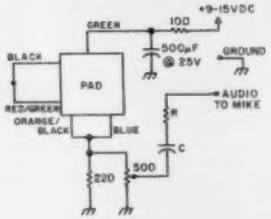
This time delay circuit is easily adaptable to turning off an alarm system and resetting it after a preset period. The values shown will keep the load activated for about 10 seconds, but can be adjusted for values up to many hours. Reprinted from LIMARC Log.


S1 SPST TOGGLE
T1 MAINS TRANSFORMER, SECONDARIES 2 X 6.3V @0.15A OR MORE (SEE TEXT)
6.3V
6.3V
D1-D4 SILICONE BR RECT
100 PIV 2A
A.C MAINS
L
N
E
OUTPUT
R1 390Ω 1/4W 10%
VR1 500K POT LINEAR
TR1 2N4871
B2
E
B1
R3 4.7K 1/4W 10%
TH1 CRS1/05
A
C
G
R2 180Ω 1/4W 10%
C1 0.015µF PLASTIC FOIL (SEE TEXT)
MISCELLANEOUS
2 INSULATED SOCKETS
CONTROL KNOB
TO5 CLIP-ON HEATSINK
VEROBOARD, 0.15 IN. MATRIX
4 RUBBER FEET
3-CORE MAINS LEAD
MATERIALS FOR CASE (SEE TEXT)
WIRE, SOLDER, ETC
CRS1/05 LEAD-OUTS
2N4871 LEAD-OUTS
B2 E B1

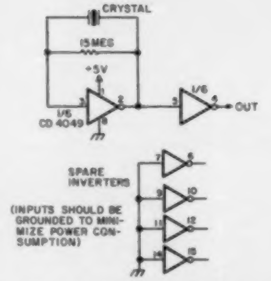
This circuit enables you to use a 12 V dc motor off the ac power line. The motor must be rated at 1 Amp or less. Reprinted from Radio & Electronics Constructor.


120Ω
5µF
3/4 7400
R2 1K
10K
7493
5K
4.7K
2.5K
15Hz SYNC PULSES (TTL LEVEL)
CP
Q
+12V
741
TO VCO
-12V
2.2K
R1 10K
+12V
+5V
-12V

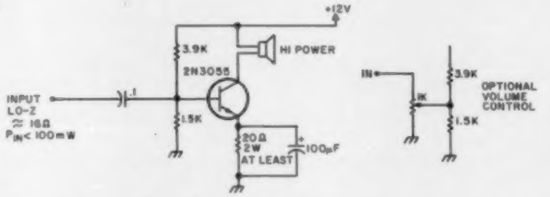
A grey scale generator for SSTV. Connect the output to the VCO of the camera. Gives 2300 Hz, 2100 Hz, 1900 Hz, 1700 Hz, and 1500 Hz. R1 is level adjust on the entire waveform. R2 sets the oscillator frequency to about 75 Hz. Thanks to Roger Peckham WA7SBH.


+9-15VDC
GREEN
10Ω
500µF @ 25V
GROUND
BLACK
PAD
RED/GREEN
ORANGE/BLACK
BLUE
AUDIO TO MIKE
R
C
220
500

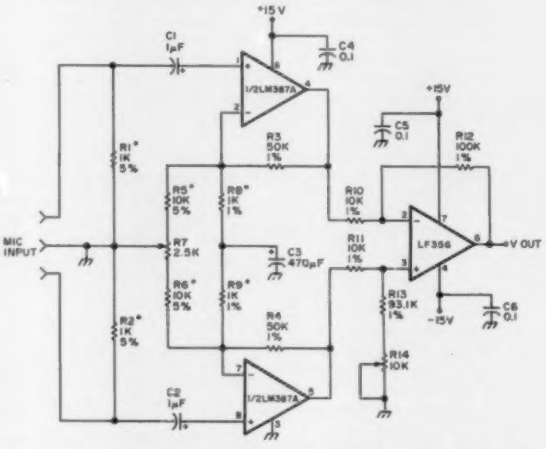
Touchtone pad circuit for finicky repeaters. R will be 100k to 4 megs, depending on the mike circuit. Select a value that doesn't distort mike audio but gives enough deviation from pad. C is .1 uF electrolytic. Use 10 uF for carbon mikes. Reprinted from SCRAMSGRAM.


CRYSTAL
15MEG
+5V
1/6 CD 4049
1/6
OUT
SPARE INVERTERS
(INPUTS SHOULD BE GROUNDED TO MINIMIZE POWER CONSUMPTION)

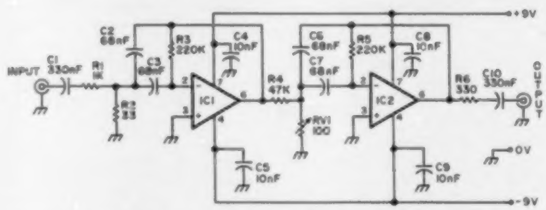
This very simple clock oscillator uses only three components. It's usable to 5 MHz and draws less than 10 mA. Four spare inverters are available for use elsewhere in the circuit. Thanks to Bruce Brown WB4YTU/WA9GVK.


+12V
3.9K
HI POWER
2N3055
INPUT LO-Z ≈ 16Ω P IN < 100mW
.1
1.5K
20Ω 2W AT LEAST
100µF
IN
1K
3.9K
OPTIONAL VOLUME CONTROL
1.5K

This simple audio follower stage adds punch to low power radios and tape recorders. It will provide 5 to 7 Watts output with a 750 mW input. The optional volume control is for fixed volume sources. Be sure to use a hefty speaker, as most speakers will blow out. Thanks to Steve Uhrig WA3SWS.


+15V
C1 1µF
C4 0.1
1/2LM387A
+15V
C5 0.1
R1* 1K 5%
R3 50K 1%
R12 100K 1%
R5* 10K 5%
R8* 1K 1%
R10 10K 1%
MIC INPUT
R7 2.5K
C3 470µF
R11 10K 1%
LF356
V OUT
R6* 10K 5%
R9* 1K 1%
R13 93.1K 1%
-15V
C6 0.1
R2* 1K 5%
R4 50K 1%
R14 10K
C2 1µF
1/2LM387A

This low noise balanced mike preamp uses the ability of op amps to amplify differential signals while rejecting common mode ones, thus eliminating the transformer and its inherent susceptibility to hum pickup. Reprinted from Audio Handbook, *National Semiconductor.*


+9V
C2 68nF
R3 220K
C4 10nF
C6 68nF
R5 220K
C8 10nF
INPUT
C1 330nF
R1 1K
C3 68nF
R4 47K
C7 68nF
R6 330
C10 330nF
OUTPUT
IC1
IC2
R2 33
RV1 100
0V
C5 10nF
C9 10nF
-9V

An active CW filter that can use a variety of ICs, including the 741, 748, and 301A series. The first stage is fixed-tuned. The second can be set the same, or slightly offset to provide double humped bandpass. Reprinted from Radio ZS.

Novice Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.

Q. What is a simple solution to low vfo drive on 10 meters?

A. A vfo will not always work simply by unplugging a crystal and replacing it with a vfo. Here are some of the reasons for this. The output impedance of the vfo must be proper for the oscillator circuit used in the rig. You cannot drive a rig on 10 meters with an 80 or 160 meter vfo output, even though 7 MHz crystal for 10 meters is used. There must be enough rf output from the vfo for proper drive on 10 meters.

Most crystal oscillators have a high impedance input. If the vfo output is low impedance, there may be trouble. Changing from low- to high-Z requires another tuned circuit or redesigning the oscillator. Generally, if the vfo has low-Z output and the right oscillator a high-Z input, simply link-couple a resonant parallel-tuned circuit to the vfo, with the tuned circuit going to the oscillator.

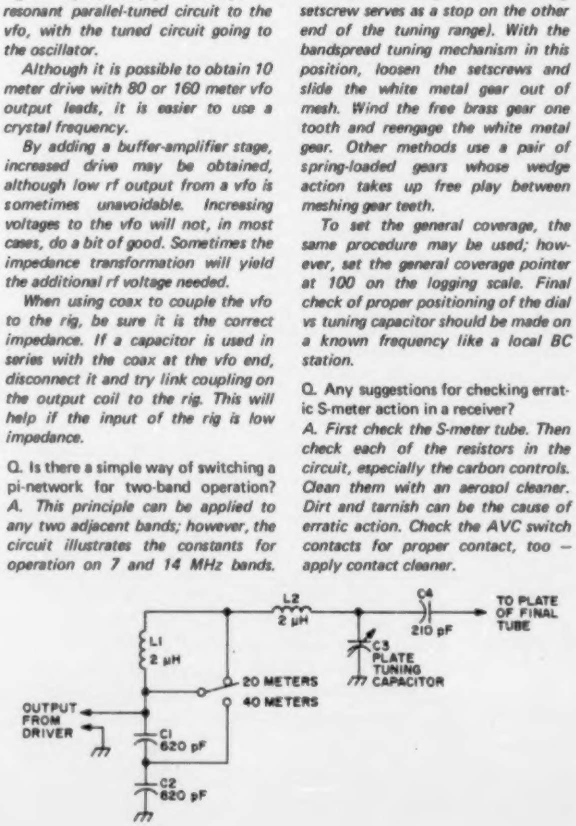
Although it is possible to obtain 10 meter drive with 80 or 160 meter vfo output leads, it is easier to use a crystal frequency.

By adding a buffer-amplifier stage, increased drive may be obtained, although low rf output from a vfo is sometimes unavoidable. Increasing voltages to the vfo will not, in most cases, do a bit of good. Sometimes the impedance transformation will yield the additional rf voltage needed.

When using coax to couple the vfo to the rig, be sure it is the correct impedance. If a capacitor is used in series with the coax at the vfo end, disconnect it and try link coupling on the output coil to the rig. This will help if the input of the rig is low impedance.

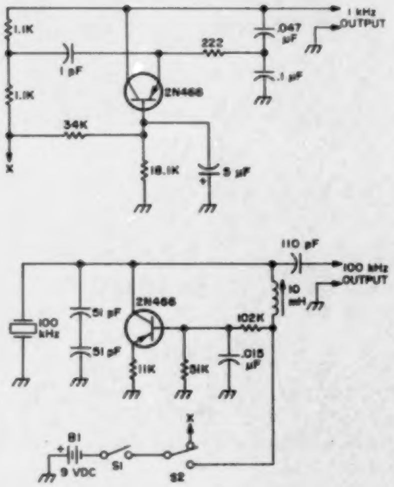
Q. Is there a simple way of switching a pi-network for two-band operation?

A. This principle can be applied to any two adjacent bands; however, the circuit illustrates the constants for operation on 7 and 14 MHz bands. The effective inductance is 4 uH and the capacitance is 620 pF with the control switch, SW, set at the 7 MHz position. At 14 MHz the inductance and capacitance are reduced to 2 uH and 310 pF respectively.



Q. Is there a circuit diagram for a 1000 Hz af oscillator which can also double as a 100 kHz crystal calibrator? It must be transistorized and compatible for use with an SSB transceiver.

A. Suggest you use 5% resistors (½ W) if available, in the circuit. The output of the af oscillator can be switched into the "mike" position of the rig, as shown in the figure.



Q. What can cause backlash in a gear-driven tuning system, and how can it be corrected?

A. Anti-backlash gears in receivers sometimes become unwound or springs pop out of place due to shock in handling. To correct it, set the bandspread pointer at zero on the logging scale (have the bandspread capacitor fully meshed). In one model receiver, the white-metal gear should be set so that its long setscrew is 1/8 in. from the stop pin (this long setscrew serves as a stop on the other end of the tuning range). With the bandspread tuning mechanism in this position, loosen the setscrews and slide the white metal gear out of mesh. Wind the free brass gear one tooth and reengage the white metal gear. Other methods use a pair of spring-loaded gears whose wedge action takes up free play between meshing gear teeth.

To set the general coverage, the same procedure may be used; however, set the general coverage pointer at 100 on the logging scale. Final check of proper positioning of the dial vs tuning capacitor should be made on a known frequency like a local BC station.

Q. Any suggestions for checking erratic S-meter action in a receiver?

A. First check the S-meter tube. Then check each of the resistors in the circuit, especially the carbon controls. Clean them with an aerosol cleaner. Dirt and tarnish can be the cause of erratic action. Check the AVC switch contacts for proper contact, too — apply contact cleaner.

Q. When a beam is mounted on a high tower, how can you determine whether or not the transmission line (coax) becomes disconnected from the beam?

A. Simply check the final loading control. Also, use a grid dip meter. In most cases you will find that the antenna won't load as it did before. If a pi-network is used, you will find that the final loading control setting for a particular band will be way off — even for a partial load.

Q. What is a product detector?

A. Some receivers actually contain two detectors — a standard diode for AM reception plus a second circuit designed for CW and SSB reception. In such configurations, the second detector is referred to as a product detector — actually just another name for a converter-like circuit with a built-in bfo.

Many feel that the product detector exhibits limited or no improvement over the standard diode arrangement. Others — particularly the dyed-in-the-wool sidebanders — claim it provides significantly increased intelligibility characteristics.

Q. When operating, isn't a Q-multiplier supposed to act as a good, sharp crystal filter? Also, what causes squeal when its external controls are manipulated?

A. The majority of Q-multipliers installed in commercial ham receivers provide for internal adjustment. Usually, the adjusting control is set just below the threshold of oscillation. The Q-multiplier will not usually cause a "ringing" effect similar to that experienced when phasing a crystal filter.

For proper nulling or notching action, Q-multiplier controls must be carefully adjusted in vernier steps. A squeal indicates improper internal adjustment.

Q. How much difference is there in the velocity factor between coaxial and open-wire lines?

A. The velocity factor is a ratio of the actual wave velocity along a transmission line to the wave velocity in the air or free space. It varies from .65 to .85 with solid dielectric coax. Open-wire line's velocity factor is between .95 and .98.

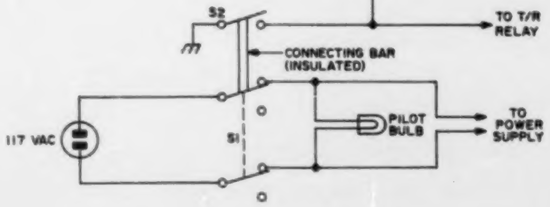
Q. Can the 6146B be used to any advantage in a transmitter designed to use the 6146?

A. Yes, the 6146B is a direct replacement for the 6146, and — if power is available — the change is worthwhile. The 6146B is a better tube than the old 6146 and does give more rf power output.

Q. What circuit can be used to automatically ground an antenna when the main power switch is open?

A. See the figure. SW1 is a DPST switch which feeds 115 V ac to the

Continued on page 27



SSTV Test Generator

- - invaluable diagnostic tool

D. W. Ishmael WA6VVL
1118 Paularino Ave.
Costa Mesa CA 92626

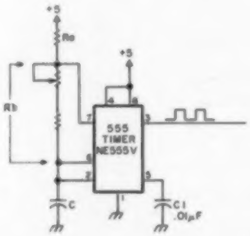
Probably the biggest obstacle facing amateurs building their own SSTV monitor is finding a stable slow scan signal source to properly adjust the monitor circuitry. This is especially true if the reader decides to design his own monitor or deviates from an existing design. The monitor itself generally cannot be used as a test unit because all the circuitry has to be adjusted and operating properly before anything can be viewed on the monitor's CRT.

This article describes an SSTV pattern generator which produces a continuous, high quality, 4x4 checkerboard SSTV signal which can be used with a triggered sweep oscilloscope to follow the slow scan signal through the monitor circuitry. The generator can be used to improve the design of an existing SSTV monitor or as a diagnostic tool to repair one.

The pattern generator described in this article is an adaptation of the circuit designed by Bert Kelley K4EEU.[1] NE555V timers are used as astable oscillators in place of the crystal oscillators, and the digital logic has been modified to produce a 4x4 checkerboard pattern.

After reading Bert Kelley's article on building a slow scan TV test generator, I didn't appreciate the need for such an instrument until seriously designing and building my own monitors; now I am convinced that anyone undertaking such an adventure should have a similar instrument.

The "front end" of my monitor at the present time contains circuitry from WB9LVI,[2] W6MXV[3] and myself. It is more or less the same route that WA9MFF took with his monitor,[4] a conglomerate of designs. Breadboarding the circuitry was relatively easy, but finding a stable signal source proved to be the biggest problem. I was able to use an audio oscillator to initially adjust the limiter, pulse counting discriminator, video amplifier, and sync separator, but fine tuning them for maximum performance was impossible using this method. A cassette recorder was used for a time, but was unsatisfactory from my standpoint as the video content was constantly changing, as was the video quality (I didn't have an opportunity to use a tape recorded by an SSTV manufacturer so I can't comment on them as an SSTV signal source). Remembering K4EEU's article, I resurrected it from my SSTV files, building the generator described in this article.



$$\text{frequency of oscillation} = \frac{1.44}{(Ra + 2\,Rb)\,C}$$

$$\text{duty cycle} = \frac{Rb}{Ra + Rb} < 50\%$$

Fig. 1. 555 timer connected as an astable oscillator. C1 is recommended by the manufacturer.

1200, 1500, and 2400 Hz Reference Oscillators

The primary attraction of the K4EEU generator is its inherent stability, accuracy, and lack of adjustments provided by three crystal controlled reference oscillators. I felt, however, that the stability of 555 timers was adequate for most SSTV alignment applications and designed my generator accordingly.

Several dozen Signetics NE555V timers manufactured over a two year period were tested over a temperature range of 25°C-55°C in an oil bath to determine their temperature coefficients (tempcos) and, therefore, their suitability as reference oscillators when operated in the astable mode. A test fixture was constructed so that only the NE555V was placed in the oil bath and not the external timing components. Fig. 1 shows a 555 timer connected as an astable oscillator. The tempcos of the NE555V timers measured .045% to .07% per degree centigrade (/°C). After the tempcos of the 555s were determined, a number of different timing components were included in the oil bath to check the overall oscillator tempcos. Best performance was obtained using precision wirewound resistors and metallized polycarbonate film capacitors with oscillator tempcos measuring .05% to .08%/°C. The worst performance was obtained using carbon resistors and disc ceramic capacitors with oscillator tempcos exceeding .3%/°C.

As a compromise between performance and parts availability, I used RN55/60C (50 ppm) metal film resistors, cermet 15 turn trimpots, and metallized polyester capacitors. Using these components, oscillator tempcos did not exceed .1%/°C, which corresponds to 1.2 Hz/°C for the 1200 Hz sync oscillator, 1.5 Hz/°C for the 1500 Hz black oscillator, and 2.4 Hz/°C for the 2400 Hz white oscillator.

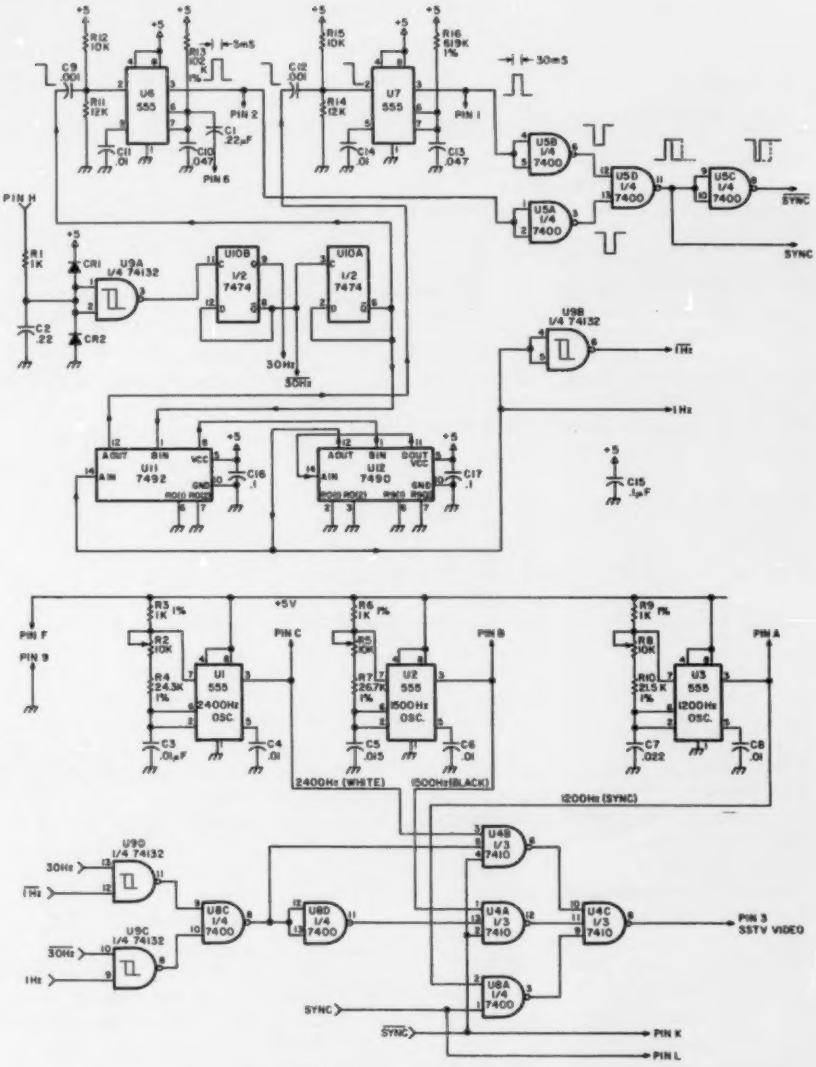

U6 555
U7 555
R12 10K
R11 12K
R13 10K
R15 10K
R14 12K
R16 619K 1%
C9 .001
C12 .001
C11 .01
C10 .047
C1 .22μF
C14 .01
C13 .047
5mS
30mS
PIN 2
PIN 1
PIN 6
PIN H
R1 1K
C2 .22
CR1
CR2
U9A 1/4 74132
U10B 1/2 7474
U10A 1/2 7474
30Hz
30Hz
U9B 1/4 74132
1Hz
1Hz
U5B 1/4 7400
U5A 1/4 7400
U5D 1/4 7400
U5C 1/4 7400
SYNC
SYNC
U11 7492
U12 7490
C16 .1
C17 .1
C15 .1μF
+5
+5V
PIN F
PIN 9
PIN C
PIN B
PIN A
R3 1K 1%
R2 10K
R4 24.3K 1%
U1 555 2400Hz OSC.
C3 .01μF
C4 .01
R6 1K 1%
R5 10K
R7 26.7K 1%
U2 555 1500Hz OSC.
C5 .015
C6 .01
R9 1K 1%
R8 10K
R10 21.5K 1%
U3 555 1200Hz OSC.
C7 .022
C8 .01
2400Hz (WHITE)
1500Hz (BLACK)
1200Hz (SYNC)
U9D 1/4 74132
U9C 1/4 74132
U8C 1/4 7400
U8D 1/4 7400
U4B 1/3 7410
U4A 1/3 7410
U4C 1/3 7410
U8A 1/4 7400
PIN 3 SSTV VIDEO
SYNC
SYNC
PIN K
PIN L

Fig 2. Schematic, SSTV pattern generator.

Circuit Description

Referring to the schematic, U1, U2, and U3 are 555 timers used as 2400 Hz, 1500 Hz, and 1200 Hz reference oscillators. The component values specified in the parts list have been selected so that the oscillator frequencies can be adjusted ±16-19% from nominal to allow for normal component variations. To improve the oscillator's ability to be set, R2, R5 and R8 can be changed to 2k and R4, R7, and R10 trimmed (selected) for the correct frequency. There is nothing critical about the values specified and they can be changed as required, but keep the duty cycle in the 47-49% range. Table 1 provides nominal values of Rb for preferred values of C when Ra equals 1k. Nominal values include 1/2 the value of the series trimpot selected. The outputs of U1, U2, and U3 are brought out to pins C, B, and A.

U4 is a TTL 7410 three input positive NAND gate. U4A and U4B alternately gate the 1500 Hz black and 2400 Hz white oscillators to the input of U4C, except when inhibited by the $\overline{\text{SYNC}}$ signal from U5C. During the time that U4A and U4B are inhibited by $\overline{\text{SYNC}}$, U8A is enabled by the SYNC signal from U5D, gating the 1200 Hz sync oscillator to the input of U4C. U4C is used as a three input inverter, its output, the SSTV video output, brought out to pin 3.

U5 is a TTL 7400 quadruple 2 input positive NAND gate used as a sync adder, combining the 5 ms horizontal and 30 ms vertical sync pulses from U6 and U7. The outputs from U5D and U5C (SYNC, $\overline{\text{SYNC}}$) are brought out on pins L and K.

U6 and U7 are 555 timers used as 30 ms vertical and 5 ms horizontal sync generators. U6 is triggered from the negative edge of U10A (15 Hz) and U7 is triggered from the negative edge of U11 (1/8 Hz). Pin 6 may be externally grounded to increase the horizontal sync pulse width from 5 ms to 30 ms. This provides a 30 ms wide sync pulse at a 15 Hz rate for easily adjusting the monitor's vertical sync separator. The outputs from U6 and U7 are brought out on pins 2 and 1.

U8 is a TTL 7400 quadruple 2 input positive NAND gate. U8C combines the output of U9C and U9D and, in conjunction with inverter U8D, alternately enables/disables gates U4A and U4B. U8B is not used.

U9 is a 74132 quadruple 2 input positive NAND Schmitt trigger. U9A squares the 60 Hz ac input pin H providing fast output rising/fall times, the positive edge triggering the first dual-D FF U10B. U9B is used as an inverter for the 1 Hz output of U12.

	1200 Hz	1500 Hz	2400 Hz
.01 uF	59.5k	47.5k	29.5k
.015 uF	39.5k	31.5k	19.5k
.022 uF	26.8k	21.32k	13.14k
.033 uF	17.68k	14.04k	8.59k
.047 uF	12.27k	9.71k	5.88k
.068 uF	8.32k	6.56k	3.91k

Table 1. This chart provides nominal values of Rb for preferred values of C when Ra = 1k. Nominal values include ½ the value of the series trimpot selected.

1	Vertical Sync Pulse, 30 ms wide
2	Horizontal Sync Pulse, 5 ms wide
3	SSTV Video
6	Contact closure to ground increases the width of the horizontal sync pulse from 5 ms to 30 ms.
9	Ground
A	1200 Hz
B	1500 Hz
C	2400 Hz
F	Power in, +5V ±.25 @ 150 mA
H	6.3-12.6 Vrms ac @ 6-12 mA
K	$\overline{\text{Sync}}$ (combined horizontal/vertical)
L	Sync (combined horizontal/vertical)

Table 2. Pattern generator pin assignments.

Opposite phases of the 30 Hz output from U10B and 1 Hz output from U12 are connected to U9C and U9D, which alternately gate the 1500 Hz and 2400 Hz oscillators every 30 picture lines and 16.67 ms producing a 4x4 checkboard pattern.

U10 is a TTL 7474 dual-D type positive edge triggered FF triggered by the positive edge of U9A. U10A and U10B divide the 60 Hz output from U9A by four, producing the 15 Hz SSTV horizontal scanning frequency. The negative edge of U10A triggers the 5 ms horizontal sync generator U6 and U11. Both phases of U10B (30 Hz, $\overline{30\ \text{Hz}}$) are connected to the inputs of U9C and U9D.

U11 is a TTL 7492 divide by twelve counter and U12 is a TTL 7490 decade counter connected to divide the 15 Hz horizontal scanning frequency by 120, generating a 30 ms vertical sync pulse at the end of 120 lines or 8 seconds. Each counter contains a ÷2 element combined with a ÷5 element (7490) and a ÷6 element (7492). The schematic is not typical of two cascaded counters as they are cascaded as follows: 7492 – ÷6, 7490 – ÷5, 7490 – ÷2, and 7492 – ÷2. This connection provides the vertical scanning logic which produces the symmetrical 4x4 checkerboard pattern when combined with the horizontal logic in U9C and U9D. (In truth, the 4x4 checkerboard pattern is not symmetrical as displayed on a monitor, as 5 ms of the leading edge is blanked by the horizontal sync pulse; that is, the 1500 Hz and 2400 Hz oscillators are overridden by the 1200 Hz sync oscillators during the horizontal and vertical sync pulses.)

Construction: Printed Circuit Board

The components are mounted on a double-sided 5½" x 3" glass-epoxy circuit board fabricated to fit a standard 10 pin card edge connector with .156" spacing. I prefer not designing double-sided circuitry because of the problems encountered making them at home and the increased costs involved, but the artwork density using twelve ICs made it impossible for me to design single-sided circuitry which fit a 5½" x 3" circuit board. The artworks were prepared at home using commercially available artwork aids,[5] taped 2:1, and photographically reduced at a local photo shop. Using direct positive photoresist coated boards available from the Vector-Electronic Co. (CU70/45WE-2RN, 7 x 4½", 1/16" double-sided glass-epoxy), the boards were exposed, developed, and etched following the instructions that came with the boards. After cutting and drilling (#65 drill for IC pads, #60 drill for others), I tin plated the finished boards with Shipley LT-25 chemical plating solution.[6] After assembly, the component side is top soldered as required and jumpers soldered top and bottom in the three feed-through holes.

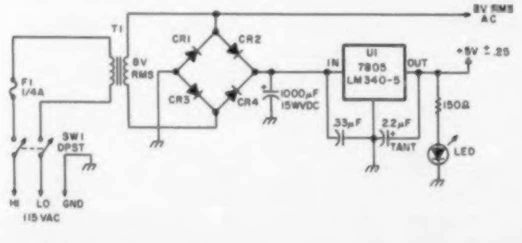


Fig. 3. This power supply satisfies the requirements for the pattern generator, but since the generator only requires 150 mA @ +5 V, it can easily be borrowed from an existing supply.

Adjustment

Obviously the easiest way to set the 1200 Hz, 1500 Hz, and 2400 Hz reference oscillators is with a frequency counter, and the values specified in the parts list should allow you to adjust the oscillators without reselecting R4, R7, or R10. If a frequency counter is not available, the oscillators can be set with a triggered scope with a *calibrated* timebase. Set the timebase to .1 ms/div, internal trigger and adjust the 1200 Hz oscillator for a width of .83 ms, the 1500 Hz oscillator for a width of .67 ms, and the 2400 Hz oscillator for a width of .417 ms. Switch to line trigger and readjust the oscillators for a stable waveform (i.e., a waveform which is not slowly drifting from right to left or left to right across the screen). This adjusts the oscillators against the 20th harmonic (1200 Hz), 25th harmonic (1500 Hz), and 40th harmonic (2400 Hz) of the 60 Hz power line and is accurate within .1% provided your timebase is calibrated, as it is very easy to adjust the oscillators against the wrong harmonic.

Operation

The pattern generator requires +5 V ±.25 @ 150 mA and 6.3-12.6 Vrms ac, and the supply illustrated in Fig. 3 satisfies the power supply requirements for the generator.

Syncing the scope on the positive edge of the horizontal sync pulse will be adequate for most troubleshooting/design, and a few

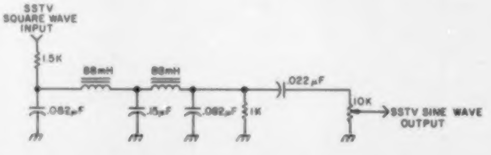
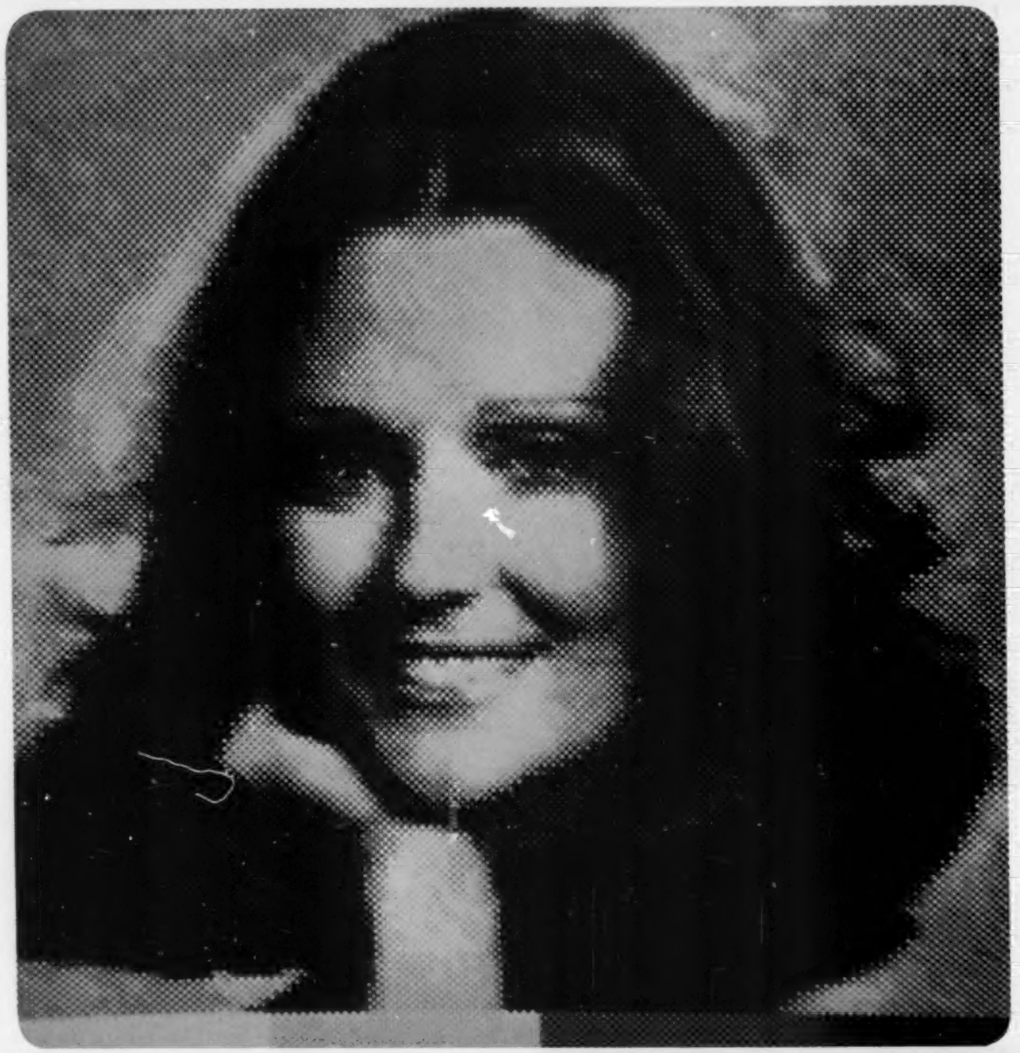


Fig. 4. This low pass audio filter used by K4EEU requires no power supplies.



This is the quality of SSTV picture you get with the new Robot Model 400 Scan Converter.

The picture shown above is from an unretouched photo taken from a monitor of a picture transmitted with the new Robot Model 400 Scan Converter. It is much sharper and clearer than was previously possible with existing SSTV equipment.

But the new solid state design and random access memory (RAM) of the Model 400 now gives you the ability to send and receive picture images just as sharp and clear as the above picture.

Operation of our new 400 Scan Converter is easy to understand and simple to work. And cost is a real breakthrough. Just **$695**

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Name______________________________

Address____________________________

City__________________State__________

Zip__________Phone________________

Parts List

C1, 2	.22 uF ±10% 250 V
C3, 4, 6, 8, 11, 14	.01 uF ±10% 250 V
C5	.015 uF ±10% 250 V
C7	.022 uF ±10% 250 V
C9, 12	.001 uF disc ceramic
C10, 13	.047 uF ±10% 250 V
C15, 16, 17	.1 uF ±10% 250 V
Note: With the exception of C9 and C12, all caps are metallized polyester Mepco/Electra Series C280AE/A or equivalent (.4" lead spacing).	
CR1, 2	1N914 or equivalent silicon
R1	1k ±10% carbon
R2, 5, 8	10k ±10% 89PR 15 turn cermet trimpots:
R3, 6, 9	1k ±1% RN55/60C 50 ppm metal film
R4	24.3k RN55/60C 50 ppm metal film
R7	26.7k RN55/60C 50 ppm metal film
R10	21.5k RN55/60C 50 ppm metal film
R11, 14	12k ±10% ½ Watt carbon
R12, 15	10k ±10% ½ Watt carbon
R13	102k ±1% RN55/60D 100 ppm metal film
R16	619k ±1% RN55/60D 100 ppm metal film
U1, 2, 3, 6, 7	NE555V IC Timer
U4	7410 triple 3 input positive NAND gate
U5, 8	7400 quadruple 2 input positive NAND gate
U9	74132 quadruple 2 input positive NAND Schmitt trigger
U10	7474 dual-D type positive edge triggered FF
U11	7492 divide by twelve counter
U12	7490 decade counter

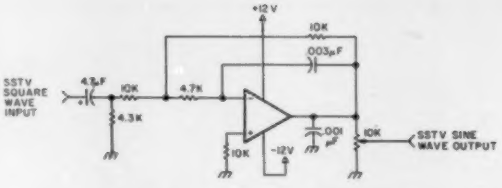

+12 V
10K
.003μF
SSTV SQUARE WAVE INPUT
4.7μF
10K
4.7K
4.3K
10K
-12V
.001 μF
10K
SSTV SINE WAVE OUTPUT

Fig. 5. W0LMD low pass audio filter.

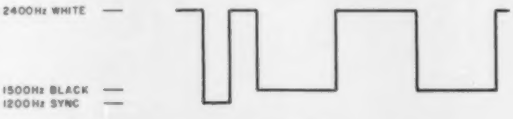


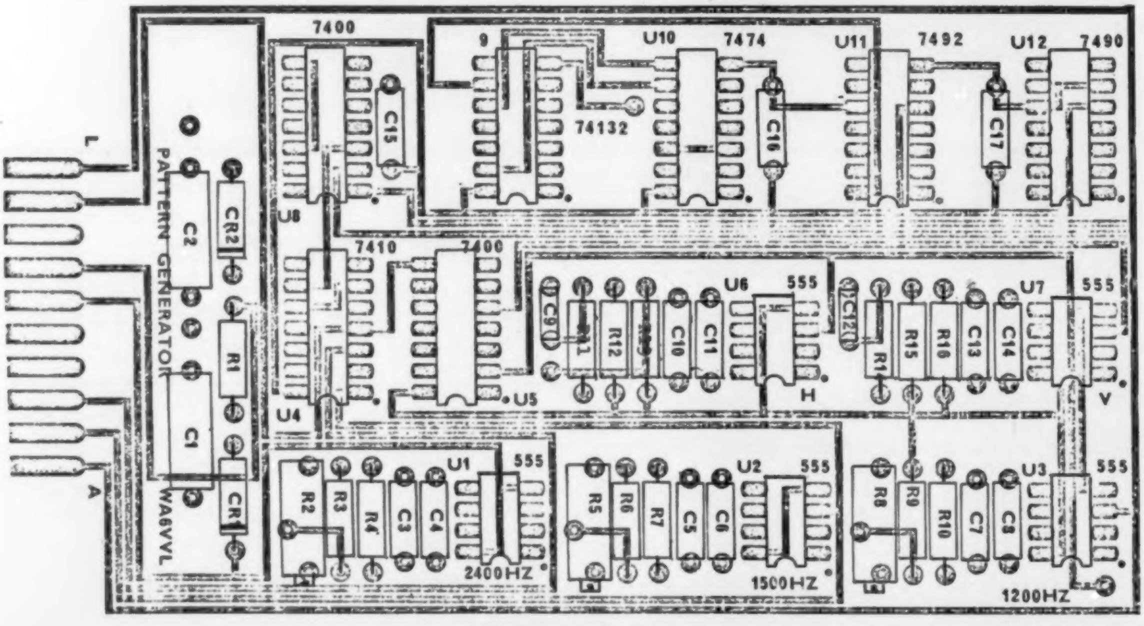
Fig. 6. Output of the WB9LVI low pass filter.

evenings spent with *73*'s *SSTV Handbook* should provide sufficient information to repair an ailing monitor with the generator. The 1200 Hz output can be used to tune the sync circuitry, and the 2400 Hz output can be used to adjust the discriminator. The horizontal and vertical sync pulses may be used as horizontal and vertical discharge pulses to drive the triggered deflection circuitry, and the checkerboard pattern can be used to optimize the gain(s) of the low pass filter for a square wave response with just enough overshoot (ringing) to enhance picture detail. The video output can be attenuated with a potentiometer to determine the minimum input for limiting, determined by limiter gain. Fig. 6 is the output of the WB9LVI low pass butterworth filter with the generator connected, and Fig. 7 illustrates the checkerboard pattern as displayed by the monitor.

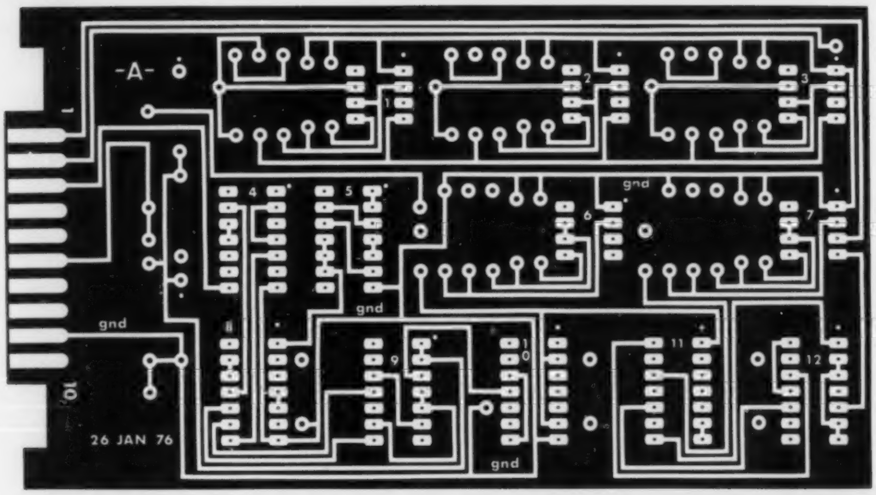
Although designed primarily for tuneup, calibration and repair, the generator can also be used for transmission by using the low pass audio filter used by K4EEU, shown in Fig. 4, to convert the square wave video to sine waves. I prefer this filter because it requires no power supplies, but an alternative is the filter used by W0LMD in several of his designs,[7,8] shown in Fig. 5.

Conclusion

Compared to the cost of an SSTV monitor, the pattern generator represents a modest investment. Like K4EEU, once the completed generator was connected to my monitor, I wondered how I survived without it, and am now convinced that anyone who wants to roll their own monitor should have a similar unit. I'll be the first to admit


7400
9
U10
7474
U11
7492
U12
7490
74132
C15
C16
C17
L
PATTERN GENERATOR
C2
CR2
R1
C1
CR1
A
WA6VVL
U8
7410
7400
U4
U5
U6
555
C9
R11
R12
R13
C10
C11
H
U7
555
C12
R14
R15
R16
C13
C14
V
U1
555
R2
R3
R4
C3
C4
2400HZ
U2
555
R5
R6
R7
C5
C6
1500HZ
U3
555
R8
R9
R10
C7
C8
1200HZ

Component layout.


-A-
1
10
gnd
26 JAN 76
1
2
3
4
5
6
7
8
9
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11
12

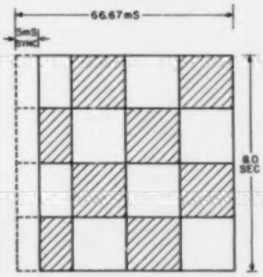
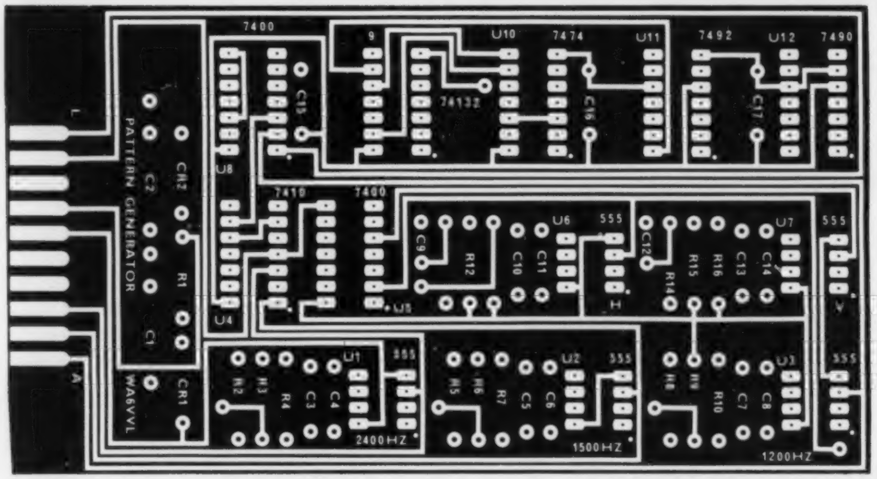

66.67mS
5mS sync
8.0 SEC

Fig. 7. Checkerboard pattern as displayed by the monitor. The pattern appears to be unsymmetrical because the leading edge is blanked by the 5 ms horizontal sync pulse.

PC layouts.


7400
9
U10
7474
U11
7492
U12
7490
74132
C15
C16
C17
PATTERN GENERATOR
CR2
C2
R1
C1
CR1
WA6VVL
U8
7410
7400
U6
555
U7
555
C9
R12
C10
C11
C12
R14
R15
R16
C13
C14
U4
U5
U1
555
U2
555
U3
555
R2
R3
R4
C3
C4
R5
R6
R7
C5
C6
R8
R9
R10
C7
C8
2400HZ
1500HZ
1200HZ
L
A

that a monitor can be constructed and aligned without it, but it should save countless hours of work should a snag develop. ■

References

[1] Bert Kelley K4EEU, "Slow Scan TV Test Generator," *Ham Radio*, July 1973, pages 6-14.

[2] Dr. George R. Steber WB9LVI, "Slow Scan To Fast Scan TV Converter," *QST*, May 1975, pages 28-36, 46.

[3] Michael Tallent W6MXV, "The W6MXV Hi-Performance Magnetic Deflection SSTV Monitor," *Slow Scan Television Handbook*, a *73* publication.

[4] Larry Pryor WA9MFF, "Homebrew this SSTV Monitor," *73*, June 1975, pages 22-30.

[5] W. H. Brady Co., 727 W. Glendale Ave., Milwaukee, Wis., 53201; Bishop Graphics, Inc., North Hollywood, Calif., 91605.

[6] Shipley Co. Inc., 2300 Washington Str., Newton, Mass., 02162.

[7] Dr. Robert Suding W0LMD, "An SSTV Keyboard," *CQ*, September 1974, pages 20-26, 79-80.

[8] Dr. Robert Suding W0LMD, "SSTV Scan Converter," *73*, August 1974, pages 73-84.

Additional References

Slow Scan Television Handbook, a *73* publication.

"Applications of Linear Integrated Circuits," Eugene R. Hnatek, Chapter 7, *The Integrated Circuit Timer*, pages 421-454.

Designing with TTL Integrated Circuits, Texas Instruments Electronic Series, edited by R. L. Morris and J. R. Miller.

The TTL Data Book for Design Engineers, Texas Instruments Inc.

Novice Q&A

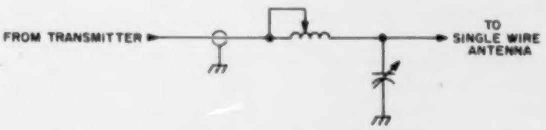
from page 21

power circuits, and SW2 is a SPST that does the antenna grounding.

Q. Using a trap antenna, erratic loading readings are obtained when it rains. What could be the cause of this?
A. The trap may be leaking. Also, there may be water entering the coax. With a good high-range ohmmeter (at the transmission line end), check the antenna — both when the weather is wet and when it is dry. A low reading when wet will indicate moisture is the problem. Disconnect and check the coax; then recheck the antenna itself with the coax disconnected.

Q. In an attempt to make a 1C meter transistorized converter work with a BC transistor radio, AM broadcast signals are received after the converter is connected to the BC set's antenna coil. Any suggestions?
A. If the antenna coil is not shielded, you will continue to pick up BC signals. Shield the coil and connect it via a coaxial cable to the output of your converter by placing a .0022 uF capacitor in series with the cable's center lead. Ground the coax shield to the BC set chassis.

Q. How can a long wire antenna be matched to a transceiver without an elaborate or heavy antenna tuner, when used away from home?
A. Any single wire antenna can be matched to the low impedance of your transceiver with the circuit shown. A surplus coil and a capacitor of 200-365 pF may be used. Using an swr meter, adjust the rotatable coil and capacitor for proper matching and maximum transmitter output. This circuit may also be used for mobile operation.


FROM TRANSMITTER
TO SINGLE WIRE ANTENNA

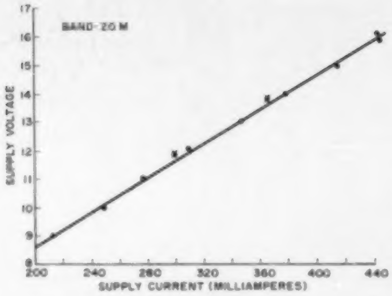


Fig. 1. Supply voltage vs. supply current.

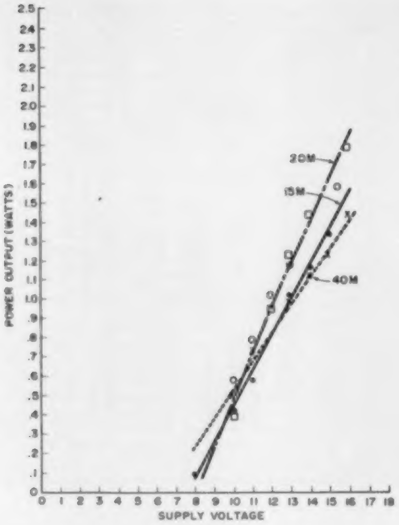


Fig. 2. Power output vs. supply voltage.

How Does Your Rig Perform?

- - an example using the HW-7

Alfred F. Stahler W6AGX
5521 Big Oak Drive
San Jose CA 95129

Some time ago I spent two weeks in Hawaii, enjoying the sun, surf and QRP operation/KH6 using the Heathkit Model HW-7 transceiver. I used two "twin lead" folded dipoles about 15 feet high and batteries for power which were recharged during the day using solar energy. The performance on twenty and forty meters was excellent: ZL1, JA0, JA1, LA1, UA0, KL7, VE5-6-7, W4-5-6-8-9-0 – all with good (S3-S8) signal reports. My log shows that nearly 50% of the stations called replied.

After returning to the mainland, I wondered about the truth of "2 Watts" and decided to measure the performance characteristics of the HW-7 transmitter. The object of this article is to present the experimental test data that I obtained with my HW-7 so that other amateurs will have more knowledge about their HW-7 and how to use it for optimum performance.

Fig. 1 shows the measured input current as a function of the applied voltage. This data was taken with the transmitter adjusted for maximum power out on twenty meters. The results are linear over the voltage range from 8-16 V. Below 8 V the unit does not always oscillate and the output waveform is very distorted.

Fig. 2 shows the measured power output of the transmitter as a function of supply voltage for the three operating bands. The frequencies used were 7.05 MHz, 14.10 MHz and 21.15 MHz. The power was determined from the measurement of the peak-to-peak voltage across a 50 Ohm, non-inductive load.

$$P = \frac{(E_{pp} \times 0.50 \times 0.707)^2}{R}$$

The peak-to-peak output voltage was measured with a Textronics Model 546 oscilloscope.

Fig. 2 shows that the power outputs on 40 meters and 15 meters are essentially the same, while the 20 meter output is considerably higher. The Heathkit manual claims that the power input varies from 3 to 2 W with increasing frequency, implying a corresponding decrease in power output. I cannot explain this apparent discrepancy between the test and published data.

As with the power input, the power output increases linearly with supply voltage. For battery operation, this characteristic is fortunate because it results in a gradual, rather than sudden, drop in output power as the battery discharges. However, the need for well charged batteries is apparent: A 2 V drop from 12 to 10 V reduces the power output by 50%.

With the power input and power output established, the next question concerned the optimum load for the transmitter. The specifications prescribe a 50 Ohm, unbalanced load. To measure the effect of load resistance on power output, a series of non-inductive, resistive loads was applied to the transmitter and the power output was measured. Fig. 3 shows the results of these measurements.

From this data it appears that the transmitter is optimally matched to a 62 Ohm load, but the difference between 62 and 50 Ohms is negligible. This data was taken on 20 meters with a 12 V supply.

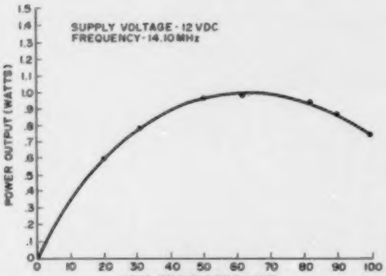


Fig. 3. Power output vs. load resistance.

In actual practice, antenna loads seen by a transmitter are seldom resistive, and usually show either inductive or capacitive reactance as well as resistance. To measure the effects of reactance on power output, various inductive and capacitive elements were placed in series with a 50 Ohm, non-inductive, resistive load. The power output was measured across the resistor.

Fig. 4 shows the power output as a function of the reactance of the load for the three bands. The power output is essentially constant for up to 10 Ohms of either capacitive or inductive reactance and drops rapidly with increasing reactance.

The range of reactance variation is limited by the variable capacitor. Since the impedance seen by a transmitter can vary over a wide range of values with antenna design, and transmission can vary over a wide range of values with antenna design and transmission line length, one should be very careful to provide the transmitter with a resistive load. With increasing reactance the "relative power" meter reads higher and higher, even off scale. The peak reading still corresponds to the peak power output, but the relative reading is valid only for non-inductive, resistive loads.

The HW-7 has a reputation for creating TVI, and mine is no exception. As far as I know, the interference is limited to TV sets in close proximity to the transmitter, but considering the DX achieved with less than 3 W, the interference range might

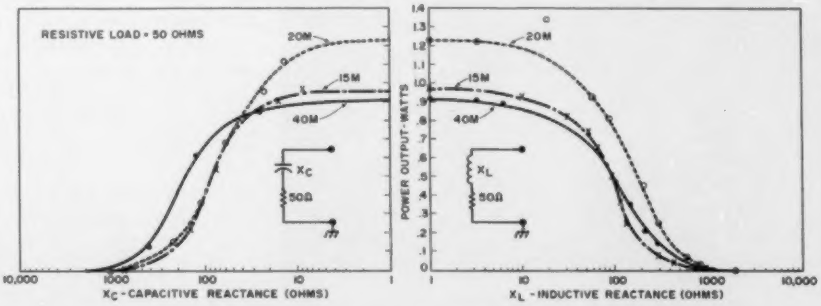


Fig. 4. Power output vs. inductive and capacitive reactance.

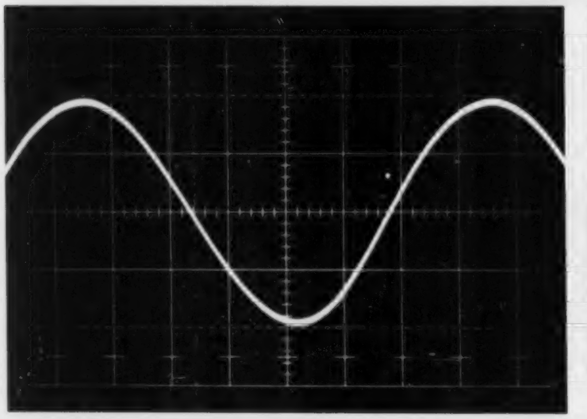


Fig. 5. Output waveform, 7.1 MHz.

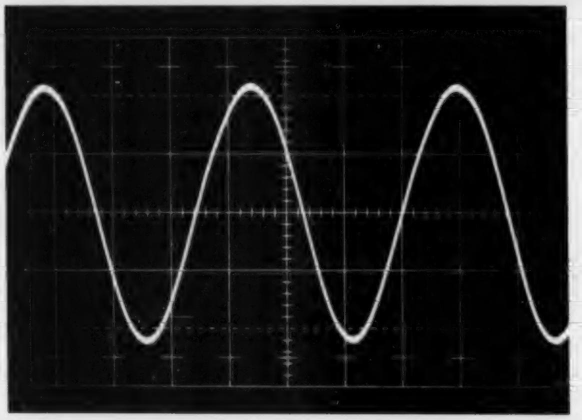


Fig. 6. Output waveform, 14.1 MHz.

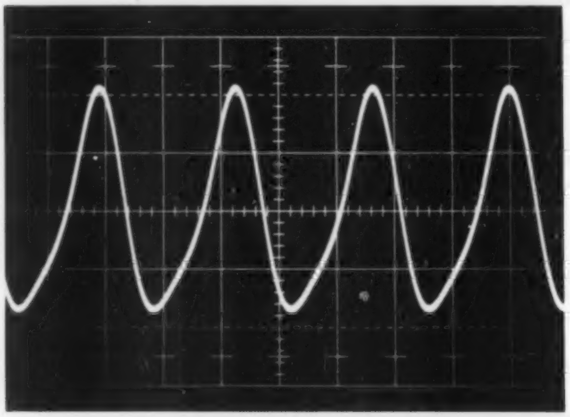


Fig. 7. Output waveform, 21.1 MHz.

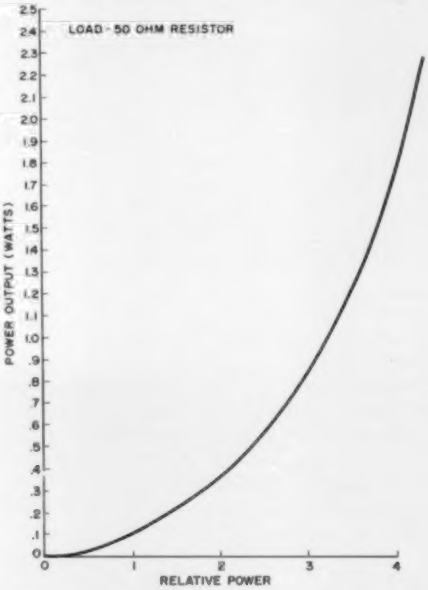


Fig. 8. Calibration curve, power output vs. relative power.

be quite large.

The output waveforms of the transmitter were measured, using the 546 oscilloscope. This data is shown in Figs. 5, 6 and 7. Each of these photos shows the output waveform measured at peak power. For all three bands, this waveform is sinusoidal with little or no harmonic content. Figs. 9, 10, and 11 show the power output at the same frequencies but with the leading capacitor turned slightly off peak relative power indication. Here the harmonic content becomes high, particularly on 15 and 20 meters, although the power output is not markedly decreased. This effect of de-tuning on harmonic content is more pronounced when de-tuned on the high frequency side of the relative power peak.

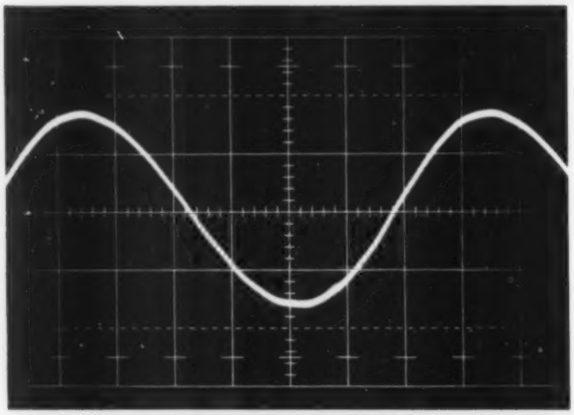


Fig. 9. 7.1 MHz de-tuned.

Fig. 8 shows a calibration curve of the relative power meter to yield absolute power output as a function of meter reading. This curve, however, is only valid for the 50 Ohm resistive load supplied with the kit.

The measured and on-the-air performance of the HW-7 transmitter shows that it is fine for QRP operation. The only possible problem areas are matching of the unit to a non-resistive load with the resultant misleading relative power indication, and that careful power peaking is required to minimize TVI. ■

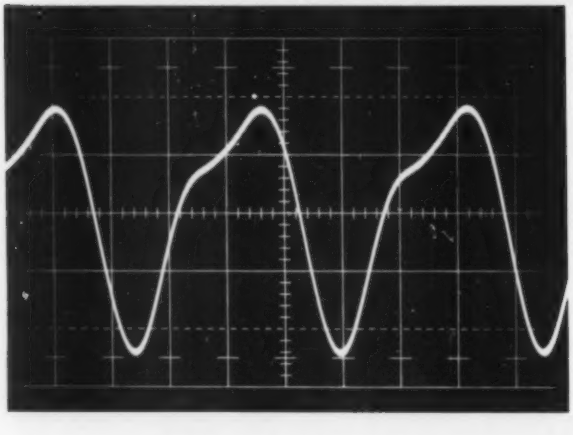


Fig. 10. 14.1 MHz de-tuned.

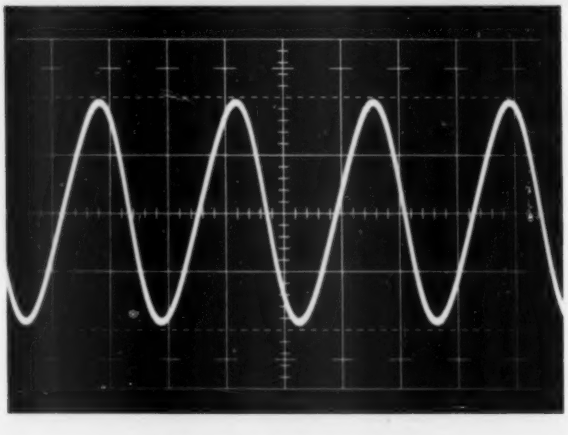


Fig. 11. 21.1 MHz de-tuned.

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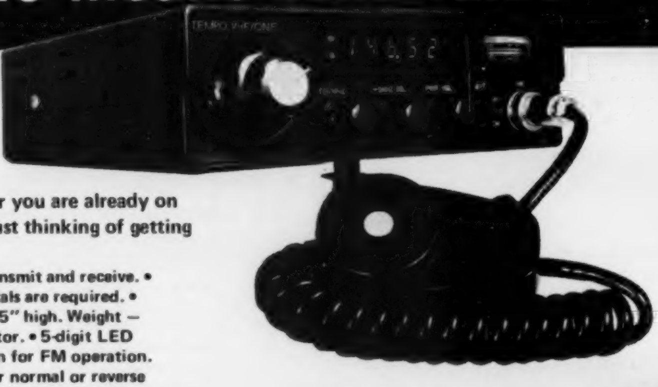

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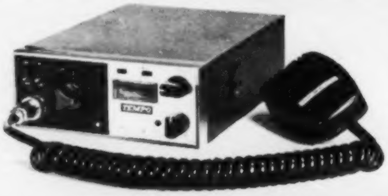

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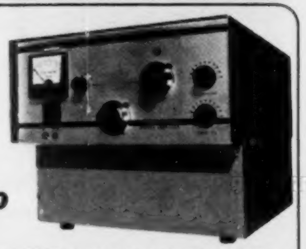

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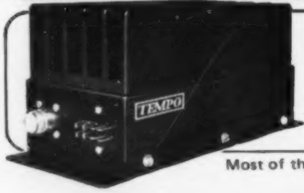

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Art and the PC Board

-- new uses for copperclad boards

Traditionally, printed circuits have been an aid in the mass production of electronic devices such as radios, TVs, telephones, etc. However, there is no reason to restrict the use of PC materials to traditional applications.

As the photographs show, they may be used for front panels, decorative plaques, and name tags. The more intricate patterns are most conveniently done by means of a photographic process, one that may be done at home. Fig. 4 and the top of Fig. 3 are two examples of this.

The wall plaques and transmitter front panel require a minimum of materials. Double-sided board is easier to get than single-sided for many reasons. It is also the best for this use as the back side will readily take solder.

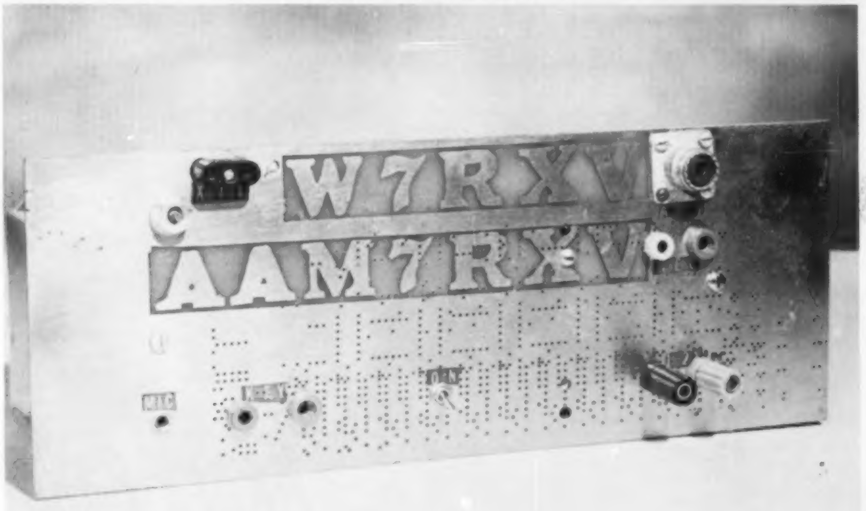

Fig. 1. ¾" letters.

Etch resist or laundry marking pens and paper masking tape are used to keep the etching solution where it belongs. The laundry markers are available for about 1/2 to 1/3 the price of the etch resist pens. (Sanford's "Rub-A-Dub" proved to be insoluble in water and ferric chloride.)

The dry transfer or press-on type of decals also work quite nicely as may be seen in Figs. 1 and 5. (Figs. 3, 4, 5 are essentially life-size.)

The results shown in the lower portion of Fig. 3 are what gave rise to the use of stencils for the plaques. I never did get along too well with a triangle and tee square.

If you have been paying attention, then by now you should have on hand the following items: triangle, tee square, ferric chloride, laundry markers, masking tape, copperclad, steel wool, stencils, and a tall pitcher of lemonade.

So as to preclude two trips to the store, the photo chemicals may be picked up too. Kodak's KPR system has proved to be quite reliable. The information that came with it seemed to be lacking in detail. More about that method later.

As anyone who has worked with printed boards can tell you, cleanliness is next to impossible, but absolutely essential.

The side of the board with the smallest number of nicks and scratches should be scrubbed with steel wool. After it glistens, apply several drops of rubbing alcohol and wipe dry with a paper towel. Surprise, surprise, you thought the board *was* clean!

Lay the board face down on a clean paper towel and apply a nice smooth bubble free coating of masking tape to the back side. If the board is wider than the tape, then overlap the edge of the tape.

Make sure the tape is securely down against the board.

If a combination of decals and stenciled letters is going to be applied, the stencil should be used first. Take your time and fill in the stencil with plenty of ink. Any slop-over may be corrected with a razor blade or better yet, an X-acto type of blade. A large error may be cleaned up with rubbing alcohol.

Follow the manufacturer's ideas with the decals. Try to avoid rubbing the center area of closed letters. The gum that is transferred in the process may act as a resist. If that does happen it may be corrected during the etching by carefully scratching the area with a thin pointed instrument. The board should be rinsed off with cool water before trying this correction.

The borders are made by applying masking tape. Where they overlap at the corners, put down a good layer of ink first.

A little freehand artwork is used to fill in the letters and avoid the broken appearance normally associated with stencils.

The photographic process is somewhat more involved, and somewhat more expensive. If a large number of the same thing is going to be made, then the higher cost might be warranted. Club projects that require a lot of boards would be one example. There would almost certainly be enough materials left over for the processing of a few call letter tie clips, etc. Fig. 4 is an example of this. The upper part of Fig. 3 shows what can be done to dress up the drab looking company-issue type of formica name tag. Two alligator clips are soldered on the back.

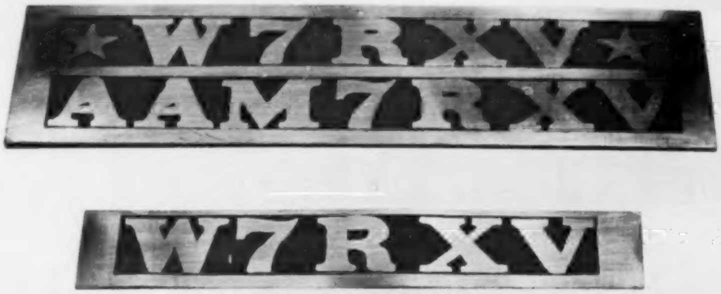

Fig. 2. 1" letters.

The boards are cleaned as above and handled with rubber gloves. Fingerprints and similar contamination must be avoided. The boards are coated with the etch resist by means of a medicine dropper. (This is done under yellow "bug" lighting.) Apply an excess of solution and flow it around the surface by tilting the board. The board is held vertically and the extra solution is drained off. Don't keep them vertical too long.

Place the boards in a preheated oven for 10 to 15 minutes. Oven temperature is 150-180° F. Remember, the boards are sensitive to light before they come out. Although this pre-bake may be skipped, it gets dry boards ready for exposure in about 20 minutes, instead of 24 hours. Your pattern is more likely to stay with you during high temperature processing, too.

Exposure time was 8 minutes at 24 inches with a BEP lamp. This is a 300 Watt photoflood. First-hand information of sunlight exposure time is not available due to the fact that there wasn't any sunlight available between the hours of midnight and 6 am when these items were made. Daylight exposure time should be about 2 minutes though.

The exposed board is dropped face up into the developer for 60 seconds. An aluminum cake pan with a

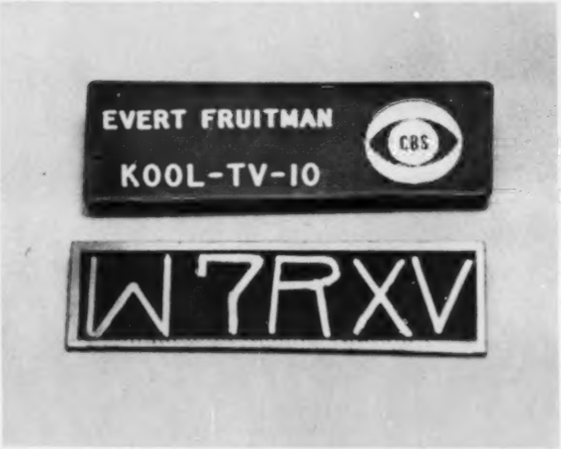

Fig. 3. Just about actual size name and call tags.

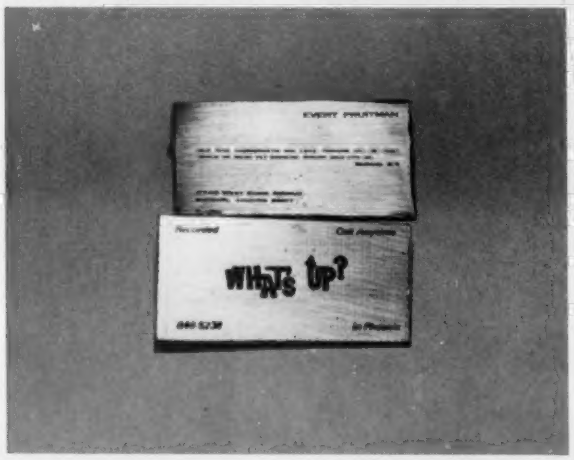

Fig. 4. Note fine resolution of photo process.

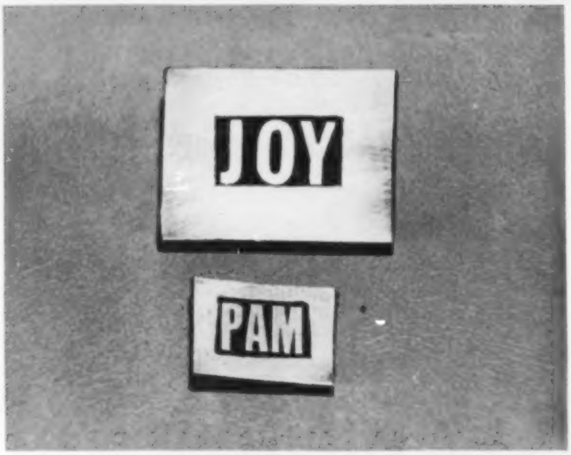

Fig. 5. Almost actual size.

sliding cover helps keep the odor to a relatively low level. Gently agitate the solution during the development. Immediately after developing, the board is given a cool running water rinse. A gentle stream of water should be directed at the surface for several seconds. A faint pattern may be visible as it dries.

The boards may be etched at this time, but it is better if they get a post bake for about 10 minutes at 180° F. This may be done in normal room lighting.

The developer may be reused. Several ounces of developer may be poured into a small can with a tight fitting lid and used until it starts looking a bit dirty. Not the most scientific method for determining the end point, but quite practical.

The smallest available quantity of resist is a quart. That will do many boards. The developer comes in gallon cans. Generally speaking, the photo stores can tell you who handles the KPR series of chemicals or can order them for you.

There are some canned spray photoresists at some of the radio stores. We tried some of the canned variety but they didn't seem to work too well. Either they had been sitting on the store shelf too long (and in the Arizona heat that may not take too long either), or the chemistry needed to be worked out better.

After the boards have been etched and dried, they may be cleaned with steel wool. There are spray lacquers that make a nice durable coat. For best results, give them a 10 minute bake at about 180° F. A coating of the YF's clear fingernail polish does wonders for the smaller items such as the name tags, tie clips, etc. The tape is removed from the back and alligator clips, safety pins, etc., may be soldered in place.

It might be in order to give some details about the etching process. There are many fine comprehensive articles on the subject, but this isn't going to be one of them.

Everyone seems to have his own favorite method and etchant. We like ferric chloride. It is readily available and almost harmless. It does stain hands and clothing, the latter on a permanent basis. Wear old clothes and rubber gloves. Drug stores have some types for as little as 50¢ a pair. They also carry the stencils.

The etching may be done in plastic or glass containers. DO NOT let the ferric chloride come in contact with aluminum!

One of the popular methods uses heatproof glassware, and the solution is kept heated during etching. Infrared lamps aimed from above, or a very gentle fire underneath, is one way it is done. The dish is slowly rocked during the process. The board is face up.

We took some old plastic bleach bottles and cut the top off just about in line with the center of the handle. The solution is poured into the bottle and this is placed in a pan of hot water. The heat may be left on during the process. If the boards are too long to go all the way into the solution, then use enough solution to cover at least half of the board. It is lifted up and down or used to stir the brew until etching is done. If the board is a long one, then turn it over and finish it off. This was done with the transmitter front panel and plaques shown in Figs. 1 and 2. The 1 and 2 quart size bottles are the most convenient to use for this. The boards may be rinsed off with water and examined anytime during the etching process.

The top of the bottle makes a nice funnel for pouring the used etchant back into its container when the job is completed.

It takes about 5-10 minutes with fresh warm etchant to etch the average board. If it isn't convenient to agitate the thing while it's etching, it will take quite a bit longer to finish cutting it. But it will cut.

If you don't feel like adding some fancy decorations to the shack, Fig. 6 shows that copperclad may be used as an easily machined and inexpensive and decorative material. ■

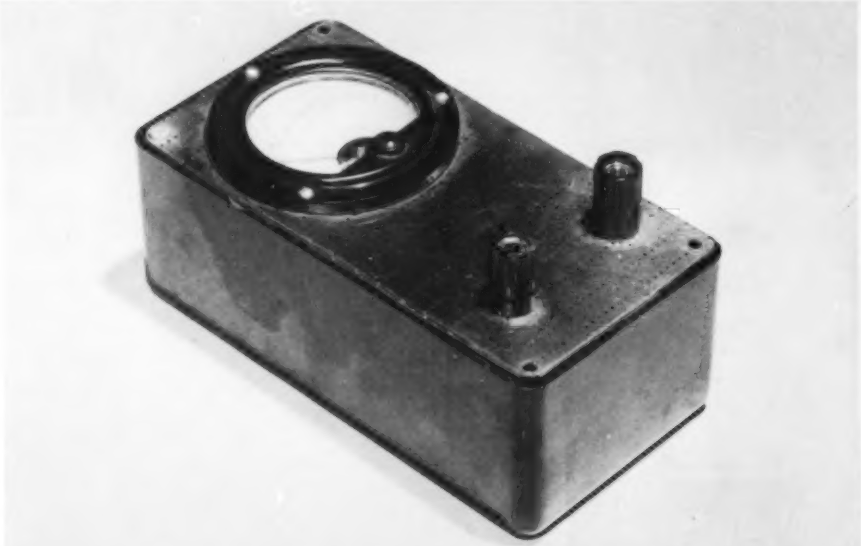

Fig. 6.

The proof of the pudding is in the eating.

The proof of Triton IV is in owner satisfaction.

Here's some of the proof . . .

K4EME — This is my second TRITON IV. They are excellent xceivers! **WA8ICK** — Luv it. Dynamite! **W9NXU** — I am very thrilled with this unit, it is great. I think you have scooped the field. **WA0AYA** — I like CW and full break-in. (Beautiful) **K3TFU** — I love the unit. **WA3VEZ** — Rig is just great. Combined with your service makes a super transceiver. **WN0SED** — Beautiful radio to use. Magnificent CW filter! Just a pure joy. **W8IIT** — I have had my TRITON IV for two months and am delighted with it. **YN1MBV** — It is a very nice rig. **W3GTX** — New features very welcome. **W0DYC** — Bought one of the first TRITON II, like it so well I updated it with a TRITON IV. **W2TBK** — It is absolutely fantastic. **WB0OPI** — I am pleased with the rig. **WA3GJA** — Very-very-very nice. Good audio quality. **W5ZBC** — The most outstanding rig I have ever used. **K8CJQ** — Excellent rig, Good filters. **W7BKK** — Very happy . . . getting excellent quality reports. **W2CET** — Power-signal reports good. **WB2UEN** — I like the compactness and appearance. **VE3IBK** — An excellent rig with superior receiving quality. **K4IVM** — I think it is tops. **WA4LOG** — I've become so used to dip, peak and adjust, this TRITON is a beautiful new experience. **KL7IHW** — Easy to set up—works great. **K4JXD** — Seems to be very FB rig. **WA7KHE** — Fantastic performance. Thanks for a fine rig. **WB4BPG** — No problems—fine rig. **VE1BZ** — Good work. **W9HQT** — Receiver better than expected, CW break-in is super. **W0AP** — Tremendous transceiver. I appreciate your engineering. **WA2ZRO** — Wonderful. **K0SFV** — Real nice rig. You thought of almost every feature and built it in. **KQ9DQ** — Beautiful. **WB0JIQ** — Beautiful radio; however, your ads do not do justice to the radio. **WN5SOH** — Very sophisticated—Easiest tuning rig ever. Very glad I bought it. **K3OJV** — Very impressed. **W4LZP** — Very good results. Put out 100 watts as good as 300 watt rigs. **WA4DQY** — I think the TRITON IV is great. **W6QXN** — Appreciate full CW break-in. **W0INH** — Enjoy light weight. **VE3CYK** — I am extremely pleased with the clarity of receiver and after putting rig on the air, received unsolicited compliments on the audio quality of the transmitter. **K4PHY** — Was 3rd in USA, first in fourth district in WWCQ contest. **W8RYU** — Own Argonaut. Both fine rigs. **W4CDA** — Compact, light weight, good engineering. **WB2WZG** — TRITON IV is the most versitile CW/SSB radio I have ever used. **WB2FMV** — Outstanding. Highly pleased with performance. **WA8ACZ** — A real nice rig. I have owned about every other make. **W5EGK** — Works nicely. **WB4ECO** — I tried this rig, a pleasure to operate. **WA4YRK** — Excellent reports on audio. **WB8NKB** — Wonderful. **W9QPQ** — An excellent rig. Love it. **W8SOP** — Makes running SSB nets a real breeze. Also good on CW nets. **WL7IRT** — Fantastic rig. **W4MDB** — Has rekindled my interest and enthusiasm in Amateur Radio to an extent I hadn't thought possible. It far out distances any competitive product at **any** price. **W6EYR** — Very nice. Been a ham for 45 years and now solid state perfection. **W2RPH** — Excellent rig. **WN0TDK** — TRITON IV is a fabulous piece of equipment. **W5VIW** — Very nice rig **WB2LQF** — Wow! **W9JCV** — Tnx for giving us a FB piece of equipment made in the USA. **W8GHO** — Very pleased. **K4KXB** — Seems to have everything desired. **W4SZ** — A pleasure to operate. **W2FKF** — Greatest rig I ever had. So far in a month 34 QSO's without one miss. Been a ham since 1922. **W4GVC** — Nothing but complements. **WB9EZE** — Well pleased with performance and simplicity of operation. **K4ETI** — Rig is great. **W0CNV** — Man—! what a rig. I've had this call since 1929. Never saw anything like it and I've seen them all! **WB2MZU** — Seems like everything the S - - - - - O - - was supposed to be at one third the price. **WN0VHE** — I think it is a very good rig. **WB9FTD** — Break-in CW is very impressive. **K0CBA** — I believe it is one of the finest HF transceivers on the market. I can't tell you how pleased I am with the noise blanker. I can get on the air from my home station again for the first time in a few years. Other rigs with noise blankers just didn't hack it. **WA7YHW** — I am very pleased with this equipment. It is certainly of high quality. **W7IIA** — Excellent equipment. **WB0RWA** — Couldn't be more pleased with it. It certainly has performed beautifully and is all I expected and more. **WB4QJT** — Like it very much — keep up the good work. **WN1YVX** — Really impressed with looks and performance. **W0NC** — Very FB rig. Performs up to specifications, an excellent design. **K8PBZ** — Already have TRITON II and IV. **W7KD** — This little "T-4" is smooth as silk . . . I've received some very flattering reports about transmitter voice quality and the CW operation is the greatest. **WN8TTO** — I found that the TRITON IV was the best rig on the market for around $800. I love it! **W2JBK** — It is absolutely fantastic. **W8FEI** — Am amazed at receiver performance. I thought I had a top notch receiver with the H - - - - - - - -! **W1FYM** — Your guarantee is refreshingly proper. **W0MOK** — Sure makes a guy look twice at his old tube type gear. **W1TFS** — Finest CW ever, CW selectivity very good. **WB6IVR** — Very satisfied with TRITON IV. Just what I was looking for to use on my yacht. Thanks. **WA8ONP** — Also have a TRITON II. I am pleased that Al Kahn and the **good guys** at TEN-TEC thought of the CW operator! **W2EMX** — Excellent Amateur gear meets and exceeds advertised claims. **W0AMJ** — It looks like there is nothing left to be desired. It is beautiful. **W6SE** — The receive function is outstanding. It is superb in transmit. **W1BV** — In love with this fantastic gem. It's so easy and a pleasure to operate. **W6ASH** — Very happy with performance. Particularly impressed with full break-in and light weight. **WA0IMS** — By far the best rig I have ever operated. I am glad I decided on the TRITON IV and not one of the other transceivers on the market. **WA8HQO** — Thank you gentlemen.

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PO Box 3313
Riverside CA 92509

The "New" 88 Channel IC-22

- - add two switches and flip

By now, I'm sure you have heard at least three tales of how to get more frequencies out of your Icom IC-22S. Well, hang on! Here comes one I think you will like.

Icom supplies a chart for programming the diode matrix of the 22S. It was from this chart I discovered you can get at least 88 channels by simply adding two small switches and programming it in a logical manner. The modification should cover over 95% of the repeaters in the United States as well as

FREQUENCY VS. DIODE PLACEMENT

	Frequency	Total "N"	D-7	D-6	D-5	D-4	D-3	D-2	+30 kHz B D-1	+15 kHz A D-0
1 –	146.010	108		x	x		x	x		
A	146.025	109		x	x		x	x		x
B	146.040	110		x	x		x	x	x	
A + B	146.055	111		x	x		x	x	x	x
2 –	146.070	112		x	x	x				
A	146.085	113		x	x	x				x
B	146.100	114		x	x	x			x	
A + B	146.115	115		x	x	x			x	x
3 –	146.130	116		x	x	x		x		
A	146.145	117		x	x	x		x		x
B	146.160	118		x	x	x		x	x	
A + B	146.175	119		x	x	x		x	x	x
4 –	146.190	120		x	x	x	x			
A	146.205	121		x	x	x	x			x
B	146.220	122		x	x	x	x		x	
A + B	146.235	123		x	x	x	x		x	x
5 –	146.250	124		x	x	x	x	x		
A	146.265	125		x	x	x	x	x		x
B	146.280	126		x	x	x	x	x	x	
A + B	146.295	127		x	x	x	x	x	x	x
6 –	146.310	128	x							
A	146.325	129	x							x
B	146.340	130	x						x	
A + B	146.355	131	x						x	x
7 –	146.370	132	x					x		
A	146.385	133	x					x		x
B	146.400	134	x					x	x	
A + B	146.415	135	x					x	x	x
19 –	146.430	136	x				x			
A	146.445	137	x				x			x
B	146.460	138	x				x		x	
A + B	146.475	139	x				x		x	x
20 –	146.490	140	x				x	x		
A	146.505	141	x				x	x		x
B	146.520	142	x				x	x	x	
A + B	146.535	143	x				x	x	x	x
21 –	146.550	144	x			x				
A	146.565	145	x			x				x
B	146.580	146	x			x			x	
A + B	146.595	147	x			x			x	x
	146.610	148	x			x		x		
	146.625	149	x			x		x		x
	146.640	150	x			x		x	x	
	146.655	151	x			x		x	x	x
	146.670	152	x			x	x			
	146.685	153	x			x	x			x
	146.700	154	x			x	x		x	
	146.715	155	x			x	x		x	x
	146.730	156	x			x	x	x		
	146.745	157	x			x	x	x		x
	146.760	158	x			x	x	x	x	
	146.775	159	x			x	x	x	x	x
	146.790	160	x		x					
	146.805	161	x		x					x
	146.820	162	x		x				x	
	146.835	163	x		x				x	x
	146.850	164	x		x			x		
	146.865	165	x		x			x		x
	146.880	166	x		x			x	x	
	146.895	167	x		x			x	x	x
22 –	146.910	168	x		x		x			
A	146.925	169	x		x		x			x
B	146.940	170	x		x		x		x	
A + B	146.955	171	x		x		x		x	x
8 –	146.970	172	x		x		x	x		
A	146.985	173	x		x		x	x		x
B	147.000	174	x		x		x	x	x	
A + B	147.015	175	x		x		x	x	x	x
9 –	147.030	176	x		x	x				
A	147.045	177	x		x	x				x
B	147.060	178	x		x	x			x	
A + B	147.075	179	x		x	x			x	x
10 –	147.090	180	x		x	x		x		
A	147.105	181	x		x	x		x		x
B	147.120	182	x		x	x		x	x	
A + B	147.135	183	x		x	x		x	x	x
11 –	147.150	184	x		x	x	x			
A	147.165	185	x		x	x	x			x
B	147.180	186	x		x	x	x		x	
A + B	147.195	187	x		x	x	x		x	x
12 –	147.210	188	x		x	x	x	x		
A	147.225	189	x		x	x	x	x		x
B	147.240	190	x		x	x	x	x	x	
A + B	147.255	191	x		x	x	x	x	x	x
13 –	147.270	192	x	x						
A	147.285	193	x	x						x
B	147.300	194	x	x					x	
A + B	147.315	195	x	x					x	x
14 –	147.330	196	x	x				x		
A	147.345	197	x	x				x		x
B	147.360	198	x	x				x	x	
A + B	147.375	199	x	x				x	x	x
15 –	147.390	200	x	x			x			
A	147.405	201	x	x			x			x
B	147.420	202	x	x			x		x	
A + B	147.435	203	x	x			x		x	x
16 –	147.450	204	x	x			x	x		
A	147.465	205	x	x			x	x		x
B	147.480	206	x	x			x	x	x	
A + B	147.495	207	x	x			x	x	x	x
17 –	147.510	208	x	x		x				
A	147.525	209	x	x		x				x
B	147.540	210	x	x		x			x	
A + B	147.555	211	x	x		x			x	x
18 –	147.570	212	x	x		x		x		
A	147.585	213	x	x		x		x		x
B	147.600	214	x	x		x		x	x	
A + B	147.615	215	x	x		x		x	x	x
	147.630	216	x	x		x	x			
	147.645	217	x	x		x	x			x
	147.660	218	x	x		x	x		x	
	147.675	219	x	x		x	x		x	x
	147.690	220	x	x		x	x	x		
	147.705	221	x	x		x	x	x		x
	147.720	222	x	x		x	x	x	x	
	147.735	223	x	x		x	x	x	x	x
	147.750	224	x	x	x					
	147.765	225	x	x	x					x
	147.780	226	x	x	x				x	
	147.795	227	x	x	x				x	x
	147.810	228	x	x	x			x		
	147.825	229	x	x	x			x		x
	147.840	230	x	x	x			x	x	
	147.855	231	x	x	x			x	x	x
	147.870	232	x	x	x		x			
	147.885	233	x	x	x		x			x
	147.900	234	x	x	x		x		x	
	147.915	235	x	x	x		x		x	x
	147.930	236	x	x	x		x	x		
	147.945	237	x	x	x		x	x		x
	147.960	238	x	x	x		x	x	x	
	147.975	239	x	x	x		x	x	x	x
	147.990	240	x	x	x	x				

14 standard simplex frequencies.

You start out by programming the radio for the 22 "base" frequencies. Icom pre-programs the first five channels; these must be reprogrammed.

You then add two small switches to the radio, to add +15 kHz, +30 kHz or both, for +45 kHz, to the base frequencies. I marked these switches "A" and "B", so (for example) channel 5AB (both A & B on) would be 146.25/85 +45 kHz, or 146.295/895. The switches can be installed almost anywhere on the radio. I added mine to the upper cover.

Chan. #	(base) program radio for	A & B off	base +15 kHz A on	base +30 kHz B on	base +45 kHz A & B on
1	146.01	01/61	025/625	04/64	055/655
2	146.07	07/67	085/685	10/70	115/715
3	146.13	13/73	145/745	16/76	175/775
4	146.19	19/79	205/805	22/82	235/885
5	146.25	25/85	265/865	28/88	295/895
6	146.31	31/91	325/925	34/94	355/955
7	146.37	37/97	385/985	40/40	415/415
8	146.97	97/97	985/985	7.60/00	7.615/015
9	147.03	63/03	645/045	66/06	675/075
10	147.09	69/09	705/105	72/12	735/135
11	147.15	75/15	765/165	78/18	795/195
12	147.21	81/21	825/225	84/24	855/255
13	147.27	87/27	885/285	90/30	915/315
14	147.33	93/33	945/345	96/36	975/375
15	147.39	99/39	405/405	42/42	435/435
16	147.45	45/45	465/465	48/48	495/495
17	147.51	51/51	525/525	54/54	555/555
18	147.57	57/57	585/585	60/60	615/615
19	146.43	43/43	445/445	46/46	475/475
20	146.49	49/49	505/505	52/52	535/535
21	146.55	55/55	565/565	58/58	595/595
22	146.91	91/91	925/925	94/94	955/955

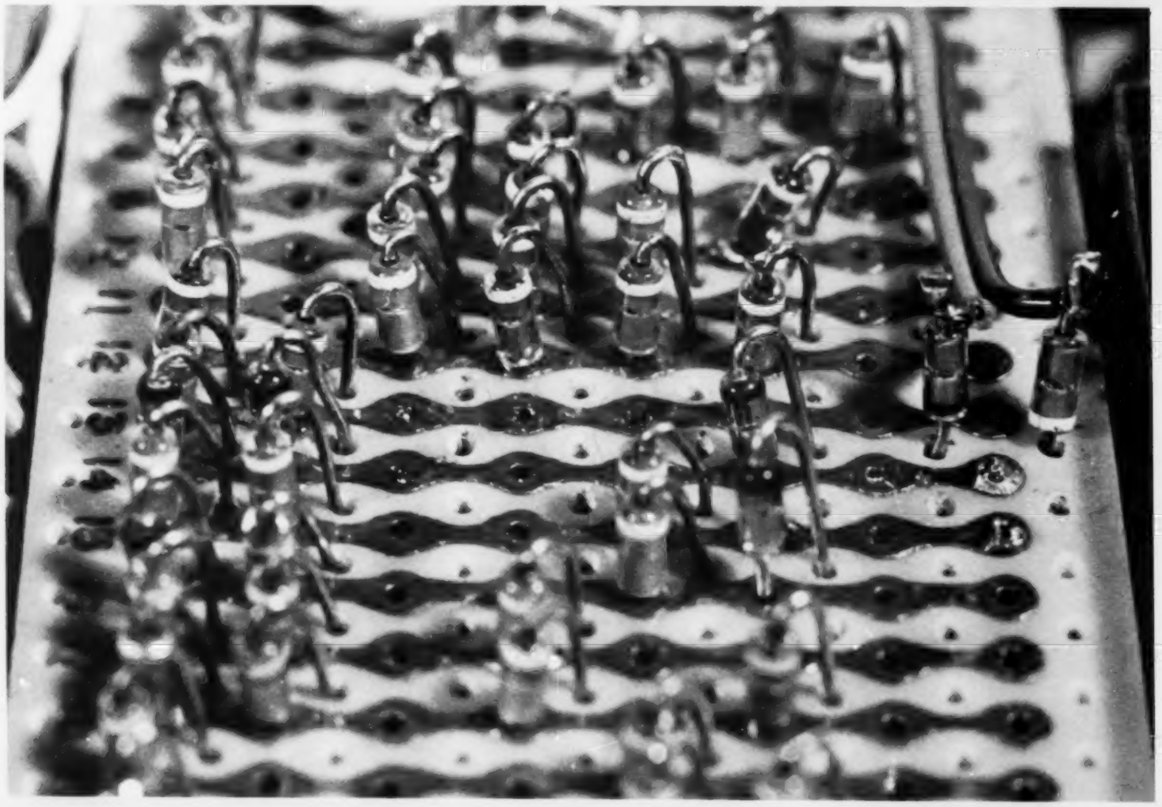
Any of the above frequencies can be reversed with the duplex a/b switch on the radio.

The common of both switches is wired to +9 volts from the matrix board. Switch "A" (+15 kHz) is wired in series with a diode (1N4148) to any hole in the top column of the matrix board marked 1 (D0), opposite the channel numbers at the bottom of the board. These holes at the top of the board are all common to one another on the back side of the board.

The second switch (+30 kHz) is wired to any hole in the second row from the top. The diodes in both cases are inserted with the banded end through the board, and then soldered to the back side of the board. Next, solder the wires from the switches to the tops of the diodes and you're ready to go!

This modification does produce one interesting operating characteristic. If either switch "A" or "B" is on, and you pass an unprogrammed channel, the Icom 22S will "lock" onto this blank channel until released by momentarily switching off power.

Just think, you've quadrupled the capacity of your 22S for the cost of two switches! Not bad at all.■



Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W
19264	1	0124:02	079.5	A	9739	1	0149:40	079.4
19276	2	0023:57	064.5	B	9751	2	0049:00	064.3
19289	3	0118:53	078.3	A	9764	3	0143:18	077.8
19301	4	0018:49	063.3	B	9776	4	0042:38	062.7
19314	5	0113:45	077.0	A	9789	5	0136:55	076.3
19326	6	0013:41	062.0	B	9801	6	0036:16	061.1
19339	7	0108:36	075.8	A	9814	7	0130:33	074.7
19351	8	0008:32	060.8	B	9826	8	0029:53	059.5
19364	9	0103:28	074.5	A	9839	9	0124:10	073.1
19376	10	0003:24	059.5	B	9851	10	0023:31	058.0
19389	11	0058:20	073'3	A	9864	11	0117:48	071.5
19402	12	0153:15	087.0	B	9876	12	0017:08	056.4
19414	13	0053:11	072.0	A	9889	13	0111:26	070.0
19427	14	0148:07	085.8	B	9901	14	0010:46	054.8
19439	15	0048.03	070.8	A	9914	15	0105:03	068.4
19452	16	0142:59	084.5	B	9926	16	0004:24	053.2
19464	17	0042:55	069.5	A	9939	17	0058:41	066.8
19477	18	0137:50	083.3	B	9952	18	0152:58	080.4
19489	19	0037:46	068.3	A	9964	19	0052:18	065.2
19502	20	0132:42	082.0	B	9977	20	0146:36	078.8
19514	21	0032:38	067.0	A	9989	21	0045:56	063.6
19527	22	0127:34	080.8	B	10002	22	0140:13	077.2
19539	23	0027:30	065.8	A	10014	23	0039:34	062.1
19552	24	0122:25	079.5	B	10027	24	0133:51	075.6
19564	25	0022:21	064.5	A	10039	25	0033:11	060.5
19577	26	0117:17	078.3	B	10052	26	0127:28	074.1
19589	27	0017:13	063.3	A	10064	27	0026:49	058.9
19602	28	0112:09	077.0	B	10077	28	0121:06	072.5
19614	29	0012:05	062.0	A	10089A	29	0020:26	057.3
19627	30	0107:00	075.8	B	10102	30	0114:44	070.9
19639	31	0006:56	060.8	A	10114	31	0014:04	055.8

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

OSCAR 7 is turned off every Wednesday to conserve power. All mode B orbits that fall on GMT Mondays are designated QRP. A limit of ten Watts ERP is recommended, with a 100 Watt limit at all other times. Higher power will drain the OSCAR batteries at an accelerated rate.

AMSAT

During the months of January and February 1977, a number of normally OFF Wednesday orbits of AMSAT-OSCAR 6 will be turned ON for a special QRP Test. The 2 to 10 meter transponder of AO-6 will be turned on for as many ascending and descending node passes as possible on the following dates: January 5, January 19, February 2 and February 16, 1977. Stations participating in this QRP Test should run no more than *TEN WATTS Effective Radiated Power* and should indicate so during their transmissions. All other stations are asked not to transmit in the AO-6 uplink passband of 145.900 to 146.000 MHz during the test. The Wednesdays chosen for the tests fall on odd days of the year which also happen to be Mode-AX days for the AMSAT-OSCAR 7 satellite. Since the orbits of the AO-6 and AO-7 begin to overlap in January and February, it has been decided that AO-7 be switched to Mode-BX for these tests in order to avoid confusion which might result if both satellites' 2 to 10 transponders were on at the same time. The 70 cm to 2 meter transponder of AO-7 should *NOT* be used during Wednesday AO-6 QRP Tests or any other Wednesday unless so scheduled by AMSAT.

All orbits of all AMSAT-OSCAR 7 Mode-B Mondays from now until further notice will be on for QRP purposes only. Stations using the 70 cm to 2 meter transponder on these days should run no more than *10 WATTS ERP*. All Mode-B users are strongly urged to use as far below the maximum recommended 100 Watts ERP as possible to help to keep the AO-7 battery voltage above the point at which the low voltage sensors switch the transponder into Mode-D, the battery recharge mode.

LAUNCH DATE FOR PHASE III SATELLITE ANNOUNCED

AMSAT has been notified by the European Space Agency (ESA) that the Phase III satellite will be accepted as a secondary payload on test flight number 2 scheduled for launch in December, 1979. The Phase III satellite, now under development by AMSAT, will contain an onboard microprocessor that will allow the satellite to control itself. The highly elliptical orbit chosen will allow amateurs to have dependable satellite communications for up to eleven hours at a time.

Funding for the Phase III spacecraft is especially critical, as AMSAT will have to purchase and assemble the one square meter of solar cells, $30,000. The funding required for Phase III will probably be $150,000.

To meet these needs, a number of fund-raising projects will be initiated. For instance, it has been suggested that we ask AMSAT members to sponsor a solar cell in the satellite.

We have noticed an increase in memberships and donations when satellite articles appear in the major magazines. Thus, one of the fund-raising projects will be to run a dozen satellite articles as a group in *73*, coinciding with the launch of A-O-D.

This was done in July, 1975, and we found the effort to be worthwhile. Several pages of pictures, text and a membership/donation form will be made available by the magazine for AMSAT to publicize the Phase III project.

To be successful, we will need articles on many subjects: DX, antennas, awards, telemetry analysis, beginners' articles, A-O-D, microprocessor applications and operating aids. Joe Kasser G3ZCZ/W3 and I are willing to provide pictures, typing and editorial support if necessary. For simplicity, we ask that the articles be submitted as a package by me around February 28, 1977. Authors will be paid directly from *73 Magazine*. In addition, some of the articles will be published in the AMSAT Newsletter.

So that I will know how the project is going and what subjects Joe and I will need to add, I would appreciate a QSL card stating your willingness to help and your subject area.

Gary Tater W3HUC
7925 Nottingham Way
Ellicott City MD 21043

FCC

In an Order released October 13, 1976, the Commission announced it had amended Section 2.302 of its Rules effective November 2, 1976 to permit the issuance, subject to availability, of specific 1 x 2 callsigns in the Amateur Radio Service (that is, callsigns consisting of one letter, one digit, and two letters) with suffixes beginning with the letter "X" to eligible applicants holding amateur Extra class operator licenses. In its Order, the Commission stated that, pursuant to its First Report and Order in Docket 20092, 58 FCC 2d 1272 (1976), it wished to make as many 1 x 2 callsigns as possible available to amateur Extra class licensees.

The Commission has now determined that 1 x 2 callsigns prefixed with the letter "N" will be available to eligible amateur Extra class applicants beginning November 2, 1976. Callsigns beginning with the letter "N" are presently allocated to the Amateur Radio Service, and this action does not, therefore, require a rule amendment. Eligible amateur Extra class applicants wishing to obtain specific 1 x 2 callsigns prefixed by the letter "N" may apply under the provisions of Section 97.51 of the Commission's Rules on or after November 2, 1976. Amateur Extra class licensees first licensed as amateurs twenty-five or more years ago and amateur Extra class licensees who obtained their amateur Extra class licenses on or prior to November 22, 1967 could apply for specific 1 x 2 callsigns on November 2, 1976. Extra class licensees who obtained their amateur Extra class licenses on or before July 2, 1974 may apply for specific 1 x 2 callsigns on January 1, 1977, and amateur Extra class licensees who obtained their amateur Extra class licenses on or before July 1, 1976 may apply for specific 1 x 2 callsigns on April 1, 1977. All amateur Extra class licensees are eligible to apply for available 1 x 2 callsigns on July 1, 1977.

1. There's far more to learn about microprocessors than can be covered in 73 even though these incredible super ICs will be in most ham gear soon. You will be able to learn about microprocessors and microcomputers in Kilobaud . . . the aim of the magazine is to make it possible for the newcomer to understand both hardware and software.

2. Kilobaud will be very interactive with its readers – which means that you'll get help from others who have already invented the wheel you're working on. Why try to solve problems that have already been solved?

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1/77

Kilobaud • Peterborough NH 03458

A No Hands Telephone Dialer

- - mobile accessory using a ROM

Donald R. McEwan WA1PNG
46 West Shore Road
Holbrook MA 02343

Here is a gadget that should appeal to the two meter FM fraternity. Living near metropolitan Boston where there are 7 autopatch repeaters, one gets many opportunities to call the police and fire departments both for oneself and to assist other amateurs.

Several months ago, while still a newcomer to two meters, I heard a phone number being dialed very rapidly. I waited until the patch was finished then asked the other amateur what he had used. It turned out to be a card dialer. I thought, "Why couldn't this be done electronically?" A card dialer is a mechanical kluge, big, bulky and requiring shuffling through cards which may be easily mutilated or lost. This autodialer may be used in motion after a little practice with binary coded decimal numbers.

Theory of Operation

The heart of this autodialer is two 256 x 4 read only memories which are addressed in parallel. A binary coded decimal address of 0 through 15 is selected by switches marked 8, 4, 2, 1. For example, if you wished to dial phone number seven in your list of numbers you would set switches 4, 2 and 1 in the up position, just a simple matter of addition. 0 is all switches down and 15 is all switches up; 8 plus 4 plus 2 plus 1 is equal to 15. 0 through 15 equals 16 addresses. After your number is set, the start switch is pressed setting pin 3 of the RS flop U1 low, which resets the binary counter U2 to the count of zero, thereby permitting U1 pin 11 to go high starting the clock U5. When the start switch is released, the next rising edge of the clock will produce a binary count of one on U2 and, at the same time, a low to enable the read only memories is produced at U1 pin 8. The binary counter is allowed to count to eight; on the rising edge of the nine count, pins 12 and 13 of U1 will both be high, giving a low on U1 pin 11, shutting down the clock which will remain stopped until the next time the start button is depressed.

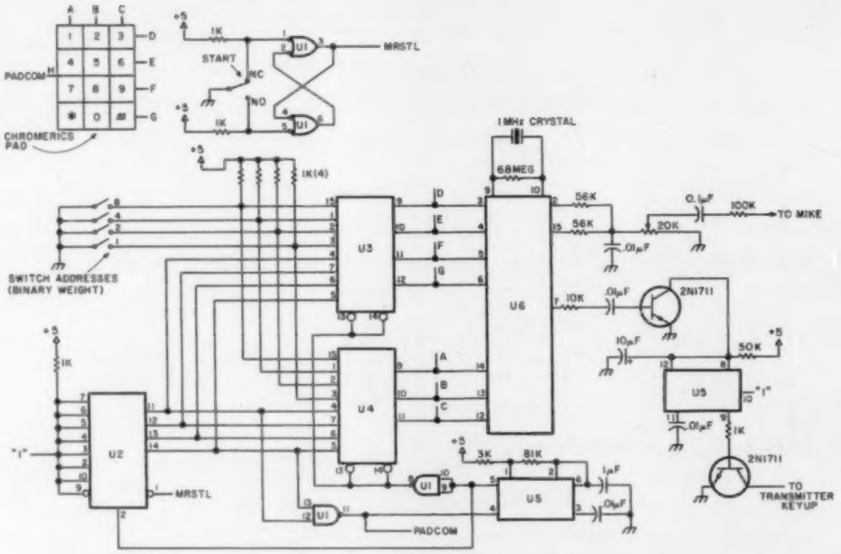


Fig. 1. U1 – 7400; U2 – 74161; U3, U4 – 256 x 4 ROM; U5 – NE556; U6 – MC14410P.

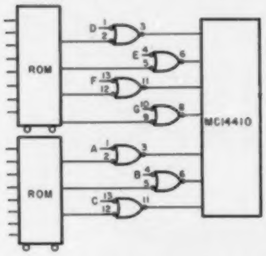
Supposing we assume that you have selected the seventh phone number appearing on your list; the address of the ROMs before accessing the start button would be 01110000. On the first count after starting, it becomes 01110001, then 01110010 for the second count, 01110011 for the third and so on.

The MC14410 takes active lows in a 2 out of 7 code. For example, the digit 1 is a low on pins 3 and 14. See Table 1.

Let's take a phone number and see how we can program the ROMs. Assuming that the first phone number which will be address 0 is 963-1234, we can write a truth table as in Table 2.

Since the binary counter always starts at zero, we don't want anything on the

Fig. 2. Necessary if TTL output ROMs are used. Added gates are 7408 ICs (2 required).



ROM outputs; also, if your phone number is a seven digit number, the same thing will be true on the count of 8. This autodialer will take either 7 or 8 digit phone numbers.

When the clock is stopped by virtue of a low being on U1 pin 11, this output can be used to enable the TT pad for repeater access or for phone numbers that don't appear in memory. It is not recommended that access numbers be stored in memory unless your favorite autopatch repeater uses Ma Bell cup-core tone decoders, as the clock is running at ten cycles per second, i.e., a seven digit phone number takes only 0.7 seconds to complete. The phase locked loop decoders that most repeaters use are not fast enough to respond to this speed. Once you have brought up the patch and are talking to Ma Bell's lines, you are only limited to the phone company decoders which will accept pulses of 40 milliseconds on time and 60 milliseconds off time, so if you wished, the speed of this autodialer could be increased a smidge.

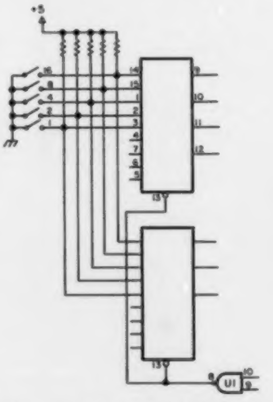
The MC14410 has a high going signal at pin 7 every time a number is selected. This is used to fire ½ of a 556 in a one shot configuration to turn on your rig, thus making it unnecessary to key your mike button when using the autodialer.

The 0.1 uF capacitor in series with the 100k resistor coming off of the wiper arm of the pot will interface with high impedance input rigs such as the Regency HR2B. Other types with low input impedances or rigs that use a lot of audio processing, such as the Icom IC-230, may require selection of other values.

The South Shore Repeater Association of Scituate, Mass. is offering this autodialer in a partial kit form consisting of an epoxy PC board and two ROMs pre-programmed to 16 phone numbers of your choosing. For further information, drop me an SASE.

For those of you who wish to roll your own, a few words of caution. The ROMs must satisfy the following conditions: (1) be enabled by a low on the chip select; (2) when disabled, all outputs must go high; (3) have tri-state or open collector outputs; (4) if open, collector outputs must be pulled up by 1k resistors. A good bet would be the Signetics 82S129 being sold by S. D. Sales Co., Dallas, Texas, for $2.95. I used the Harris HPROM-1024. TTL ROMs could be used but then you would have to OR the ROM outputs and the TT keyboard (see Fig. 2).

Fig. 3. 32 phone number version. Good choice for 512 x 4 ROM is MMI6306.



A 32 phone number dialer may be built using 512 x 4 ROMs. This requires the addition of one more switch and one more pull-up resistor which would have a number weight of 16 (see Fig. 3). ■

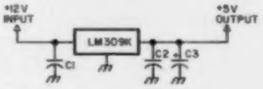


Fig. 4. Regulator. C1, C2 – 0.1 uF 25 V; C3 – 100 uF 15 V electrolytic.

Digit	3	4	5	6	14	13	12 (MC14410 pins)
1	0	1	1	1	0	1	1
2	0	1	1	1	1	0	1
3	0	1	1	1	1	1	0
4	1	0	1	1	0	1	1
5	1	0	1	1	1	0	1
6	1	0	1	1	1	1	0
7	1	1	0	1	0	1	1
8	1	1	0	1	1	0	1
9	1	1	0	1	1	1	0
*	1	1	1	0	0	1	1
0	1	1	1	0	1	0	1
#	1	1	1	0	1	1	0

Table 1.

(Switch add.) 8 4 2 1	Counter add.	(ROM outputs) D E F G	A B C	Phone nr.
0 0 0 0	0 0 0 0	1 1 1 1	1 1 1	–
0 0 0 0	0 0 0 1	1 1 0 1	1 1 0	9
0 0 0 0	0 0 1 0	0 1 1 1	1 1 0	3
0 0 0 0	0 0 1 1	1 0 1 1	1 1 0	6
0 0 0 0	0 1 0 0	0 1 1 1	0 1 1	1
0 0 0 0	0 1 0 1	0 1 1 1	1 0 1	2
0 0 0 0	0 1 1 0	0 1 1 1	1 1 0	3
0 0 0 0	0 1 1 1	1 0 1 1	0 1 1	4
0 0 0 0	1 0 0 0	1 1 1 1	1 1 1	–

Table 2.

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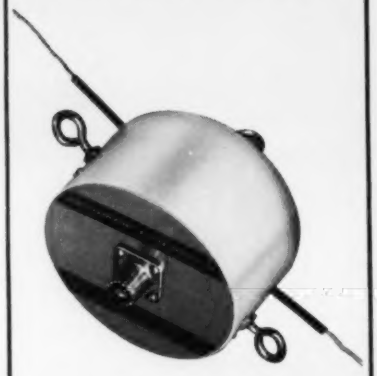

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What's the Best Antenna for 160?

- - the inverted vee compromise

The downfall of potential 160 meter operators is most usually the antenna system. For some unexplainable reason, many persons who would operate the 1.8 MHz band apparently believe, perhaps due to the frequency, that any antenna made to load will produce satisfactory results. Satisfactory results are different to different folks, but if 160 is to be enjoyed to its potential, haphazard antennas are not the medium.

It is not the intent of this article to debate 1.8 MHz antenna type merits. That discussion has been underway for decades. Anyone who has operated 160 meters has his opinion, likely biased towards his particular use of the band.

There simply is no "best" antenna for all situations, but taking into consideration expense, ease of construction, and the ability to produce all-around performance, whether it be local or DX communication, the inverted vee dipole is probably the best compromise. Full-sized quarter wave verticals are popular with the DX crowd, but 160 meter pioneer W1BB leads them all with nearly 130 countries worked on an inverted vee.

In my general geographic location, three operators spent this past winter actively chasing DX and comparing results. Two stations were inverted vee equipped, the third had a full-sized quarter wave vertical. Letters from and on-air communication with DX stations throughout the world were interesting. The quarter wave vertical station ranked, on the average, slightly better for signal consistency compared to the inverted vees, but under certain conditions and over certain paths, the inverted vees took honors. An interesting comment came from a European, who said, "When the band is marginal, your quarter wave competitor may be copyable when you aren't, but when the band is open, your inverted vee is louder." Is this mixing and reinforcement of polarization? Possibly. You can find on 160 some unusual propagation and path quirks not found on any other amateur band. In the long run, the vagaries of propagation are the great equalizer so long as the antenna performs at the best possible efficiency.

If you have a tower topped with a high frequency tri or mono-band beam, can lay an adequate ground screen radial system (and I am not certain what is "adequate"), and wish low angle DX radiation, then by all means use the tower shunt fed as well-described in one or more previous articles.[1] A 3/8 wave inverted L type antenna is an excellent performer, provided it too is operated against a good radial system. The short, commercially available, base or center loaded 20 to 30 foot verticals are poor performers even used with a good radial system. Should you not want or be able to install a radial system, the inverted vee is likely the best all-around compromise 160 meter antenna, giving hours of enjoyable stateside contacts and doing a respectable DX job when the skip is long.

The inverted vee, however, is not to be constructed and installed in a haphazard manner. Set aside a Saturday afternoon and do it properly. To assist, here are a number of suggestions and tips that will ensure a well-performing installation.

1. Use number 14 or larger copperclad steel wire for the dipole.
2. The center insulator should be a 1:1 balun like the Palomar, which covers 160 meters, or the like. Be certain the balun selected does cover 160 meters. Many do not, have a low frequency cutoff around 3 MHz, and will not work at 1.8 MHz.
3. Cut the antenna length using the standard half wave dipole formula of 468/f(MHz) or 257 feet, 10 inches at 1.815 MHz.
4. Prepare the center balun/insulator and dipole wires according to the manufacturer's instructions.
5. On the dipole far ends, use 6 to 12 inch insulators similar to those made by Hy-Gain. Do NOT use "egg" type insulators.
6. Do not solder the dipole far ends after securing through the insulators. The antenna will have to be trimmed to resonance. The wires will be soldered after resonance determination.
7. Erect the center (apex) insulator/balun as high as possible. It should be a minimum of 95 feet high to obtain a between-leg apex angle of 90°. A 50 foot height will give an apex angle of 120° and is the *maximum* angle at which the inverted vee will exhibit low angle vertical radiation. A 90° to 100° angle is highly recommended, but with less than 90°, signal cancellation and severe loss of antenna efficiency will result. These figures place the antenna ends approximately 200 feet apart and at ground level. It is desirable to have the antenna ends elevated ten or more feet, if height capabilities per-

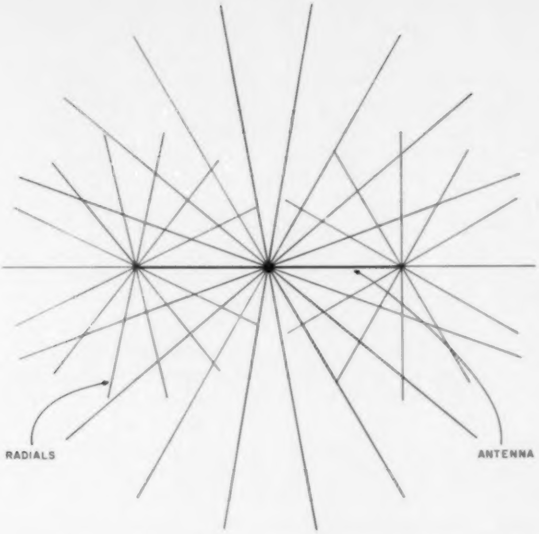

Fig. 1. Proposed ground screen radial system for 160 meter inverted vee (top view).

mit. It is also desirable to run the legs in a straight line, not folding them back upon themselves, but this may be necessary to fit the antenna into available space.

8. If the antenna center is to be supported by a metal mast or tower, it is recommended the center of the antenna be hung 3 or more feet off the support to minimize coupling. It is assumed any guy lines are broken with insulators into non-resonant lengths. Install the antenna as clearly as possible from guy lines.

9. The feed impedance of an inverted dipole is approximately 50 Ohms. The antenna may be fed with any popular 50 Ohm coaxial cable. At this frequency and amateur-allowed power levels of up to one kilowatt, there is nothing gained in using expensive RG-8 type cable. The much less expensive RG-58 type cable has very low loss and more than sufficient power handling capability at 1.8 MHz.

10. It is highly recommended that the feedline be made an *electrical* half wavelength or multiple thereof. A half wave length of foam dielectric coax, at 1.815 MHz, is 219 feet, 6 inches; solid dielectric coax has a length of 178 feet, 11 inches at the same frequency. These feedline lengths are calculated for 1.815 MHz. Should you elect operation in other available portions of the band, as shall be discussed briefly later, in addition to adjusting the dipole length, feedline length will need to be changed. Use these formulas for the calculation of an electrical half wavelength:

Foam

$$\frac{492}{f(\text{MHz})} \times 0.81 = \text{length}$$

Solid

$$\frac{492}{f(\text{MHz})} \times 0.66 = \text{length}$$

Any excess cable between the antenna and transmitter may be coiled, taped and placed out of the way.

11. Tuning the antenna may be accomplished through use of a reflectometer (swr bridge) or wattmeter having forward and reverse scales. Be certain the instrument is accurate at 160 meters. Many commonly available swr and wattmeters cut off around 3 MHz and are *entirely* inaccurate at 1.8 MHz. The least expensive swr meter having reasonable accuracy at 160 meters that I know of is the Swan SWR-3 at $10.95.

12. There are but two places to accurately measure swr: at the antenna feedpoint or along the feedline at the electrical half wave points. If you cut your feedline as described, you may do your measurements at the transmitter. Otherwise, if you want accuracy, measure at the antenna feedpoint. This may not be physically convenient, but a tuned antenna is our goal.

13. Initial swr measurements will most likely indicate the antenna is too long. This is expected due to a number of factors involving an inverted vee antenna. The antenna will need to be trimmed on *each* leg from 2 to 5 percent. Initial trimming may be up to 6 inches. Recheck the swr, trim again as necessary, but in smaller increments of 2 inches per leg.

14. Do not put absolute faith in an swr meter. If you have two, try both, being prepared to believe the one which shows the *highest swr*. Erratic readings, indication of reflected power varying under key-down conditions, may be diode saturation in the swr meter (use only as much transmitter power as needed for full scale forward reading), a faulty balun, or the like. If you are using an antenna tuner and it becomes warm or if you have difficulty loading the transmitter, suspect a problem in the antenna system that warrants immediate attention.

15. In practice you may not be able to obtain a 1:1 swr at the desired frequency. Trim for minimum swr, remembering that a 1.5:1 swr represents only 6.25% loss and a 2:1 but 11%. With the feedline cut as suggested, an swr of less than 1.5:1 is easily obtainable.

16. Inverted vee straight dipoles typically have a very narrow operating bandwidth rarely exceeding 25 kHz at the 2:1 swr points. Some additional bandwidth is possible using a folded dipole in the inverted vee configuration. Antenna and feedline lengths remain as previously described except the center balun/insulator will be a 4:1, such as a Palomar.

17. Observed radiation patterns of acute angle inverted vees suggest maximum radiation off the antenna *ends*, not broadside. Two inverted vees at right angles to one another are suggested for maximum coverage of all compass points. On certain paths, startling signal strength differences of 10 to 15 dB are not uncommon.

18. A remote-powered changeover relay may be used at the feedpoint for feedline switching between antennas. This saves the cost of one feedline but adds the cost of the relay and possibility of its failure some cold winter night. Separate feedlines are suggested.

19. Don't neglect waterproofing of connections. PL-259 connectors are not waterproof. Spray with several coats of a Krylon-type spray, wrap with good quality electrical tape and spray again.

Speculative Ground Screen Option

While I have not experimented with a ground screen radial system beneath an inverted vee, my speculation is that it may be worthwhile, particularly in locations having poor soil conductivity. Ground losses at 160 meters can cause severe absorbing of transmitted power. The suggestion would include bonding 20 to 40 radial wires to the tower base, the radial wires being .40 to .50 wavelengths long evenly spaced and fanned around the tower like spokes of a wheel. At the dipole ends and directly beneath them, a six foot or longer ground rod may be driven into the earth and bonded to it, another 20 to 40 radials each being .12 to .25 wavelengths long evenly spaced and fanned. Electrically it is not necessary to bury the radial wires.

Before undertaking the complete radial installation, try the first 4 radials directly

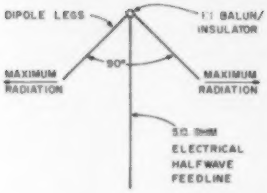

Fig. 2.

beneath the antenna center, spaced 90°. Place two radials directly beneath the antenna legs. I would anticipate a change in the antenna's resonant frequency which may be an indication the radial system would be worthwhile. Carefully controlled before and after signal strength measurements with the cooperation of a nearby colleague may provide meaningful information.

An inexpensive source of ground screen radial wire is the so-called electric fence wire available from Montgomery Wards, Sears Roebuck or most farm supply stores.

The Gentleman's Band

The 160 meter band is not an amateur band per se, but a shared band in which U.S. amateurs are permitted operation on a non-interference to LORAN navigational services basis. As protection to the LORAN service, the 160 meter band is segmented by frequency allocation and transmitter input power is related to geographic location. Traditionally popular segments of the band in the U.S. are 1.800 to 1.825 and 1.975 to 2.000 MHz. Over the years there has evolved a gentleman's agreement on usage. This agreement says that 1.800 to 1.810 is reserved for CW only, and 1.810 to 1.825 is for voice communication, although FCC regulation allows mixing of modes by not specifying CW and voice subbands. There is little U.S. CW activity elsewhere in the 160 meter band with the exception of Hawaiian stations operating between 1.995 and 2.000 MHz.

Furthermore, as relates to DXing, the gentleman's agreement says no U.S. or Canadian station may use 1.825 to 1.830 for transmitting, to allow foreign stations a segment in which to operate without being obliterated by VEs and Ws. This is the "DX Window." The agreement has worked quite well over the years with few exceptions. Five kilohertz of a 200 kilohertz band, or 2½ percent, is not too much to ask for those desiring to work international DX and as a courtesy to our foreign friends. Those who honor the agreement are commended, those who do not are respectively requested to be considerate.

If your 160 meter interest is DXing, your operation will likely be confined to 1.800 to 1.825, keeping in mind not to spill sidebands into the DX window by operating too close to 1.825 or 1.830.

If your interest is rag chewing and developing long-term friendships for which 160 is particularly noteworthy, you will likely wish to operate in those segments of the band allocated to your geographic location while keeping clear of frequencies around 1.900 where LORAN interference is fierce. This winter past saw much sideband activity moving into the 20 to 30 kHz above 1.830 and above 1.975 for QRM-free contacts. If these frequencies higher in the band are your choice, the previously given antenna and feedline formulas need to be recalculated.

Before operating 160 meters, be sure to check FCC regulations concerning power and frequency allocation for your area. The ARRL Operating Aid S-15A contains all necessary particulars. ■

Reference

[1] W5RTQ, "Shunt Feeding Towers . . .," *QST*, pg. 22, October, 1975.

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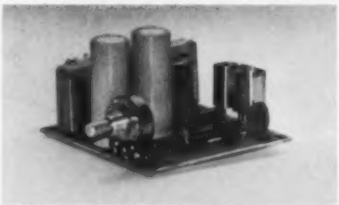

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[illegible] to [illegible]	$2
2N2905	$0.24
2N2905A	.34
2N2907*	5/$1
[illegible]	$1.50
2N3563	6/$1
2N3564	4/$1
2N3565 to 2N3569	6/$1
2N3638	6/$1
2N3638A	5/$1
2N3641	5/$1
2N3642	5/$1
2N3643	6/$1
2N3644	4/$1
2N3646	4/$1
2N3688 to 2N3690	3/$1
2N3691 to 2N3694	4/$1
2N3821	$0.80
2N3822	.70
2N3823	.40
[illegible]	.75
2N3903 to* 2N3906	6/$1
2N3919	$5.00
2N3922	5.00
2N3954	3.20
2N3958	1.15
2N3970	1.00

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2N4092	$0.75
2N4121	3/$1
2N4122	3/$1
2N4124	5/$1
2N4248	5/$1
2N4249	5/$1
2N4250	4/$1
2N4274	5/$1
2N4302	$0.25
2N4303	.25
2N4338	$1
[illegible]	3/$1
2N4391	$1
2N4392	$0.90
2N4416	2/$1
2N4416A	$0.80
[illegible] to [illegible]	$1
[illegible]	2/$1
[illegible]	2/$1
[illegible]	$2.00
[illegible]	$1
[illegible]	3/$1
2N5087	4/$1
2N5089	4/$1
2N5128 to 2N5129	6/$1
2N5138	5/$1
2N5139	5/$1
2N5163	3/$1
2N5197	$5.00
2N5199	2.50
2N5210	3/$1
[illegible]	2/$1
2N5397	$1.50
2N5432	1.90
2N5457	3/$1
2N5458	$0.30
2N5484	3/$1
2N5486	2/$1
2N5543	$3.00
2N5544	2.50
[illegible]	12.80

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[illegible]	2/$1
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CP650*	$5.00
CP651	$4.00
E100	4/$1
E101	3/$1
E102	3/$1
E175	3/$1
MPF102 to* MPF104	3/$1
MPF112	4/$1
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SE1002	4/$1
SE2001	4/$1
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[illegible]	$3.00
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CA3046	.84
[illegible]	1.45
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LM3900N	.55
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RC4194TK*	2.50
RC4195DN*	1.25
RC4195TK*	2.25
[illegible]	[illegible]
RC4558DN	.55
[illegible]	.65
[illegible]	.66
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[illegible]	.88

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74LS27 — .33
74LS30 — .33
74LS32 — .35
74LS37 — .35
74LS38 — .35
74LS74 — .50
74LS90 — .90
74LS132 — .90
74LS138 — .90
74LS139 — .90

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74LS157 — 1.10
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Ten Meters: Dead or Alive?

- - a user's report

During the month of June, 1974, after twenty years of hamming, I was mighty close to pulling the big switch on all low band operations and contemplating 2 meter FM. Exchanging signal reports and the usual trivia no longer interested me. Nor was I going to continue the bothersome task of trying to pry QSL cards from Lower Outer Magnolia. No siree, 2 meter FM here I come!

By chance, I decided to go on ten meters, before selling all of my low band gear. It was sixteen years since I had been active on my old favorite band, during the peak of one of the highest sunspot cycles on record. Those were the days, my friend.

A strange thing happened that fateful evening. The band was open on a North-South path and the 4 call area was coming through loud and clear. Who said ten was dead? I heard multitudes of stations calling CQ ten-ten. It sounded like a group of newly licensed hams with cases of nervous jitters. Hence, the stuttering. Using my old Heath HR20, HX20 receiver and transmitter along with an inverted vee cut for 20 meters, I loaded up on ten with an swr of umpteen to one. I answered a CQ from a station in Birmingham, Alabama who had his friend on frequency with him.

We exchanged the usual trivia and then it happened.

"What's your Ten-Ten number? Do you have the Yodar Kritch?" he asked. I offered him my Social Security number instead, if he was interested, but I did not know what a Ten-Ten number was. As for the Yodar Itch or something, I told him I did not have it and asked if it was catching.

"Do you have a sweetheart," he replied?

"No!" I said. "I am happily married."

His friend broke in and asked if I was a liar. "It's all the truth," I said. 2 meters here I come, the quicker the better, I thought. Let me see what 2 FM holds forth. "To each his own," I mumbled.

I was getting ready to sign off when he said, "Wait, old man, and let me explain. To promote activity on ten during the lull of the current sunspot cycle, a group in California organized a net with chapters in many of the larger cities. Some foreign countries are also forming chapters and appointing their own chapter heads. The main body is called The Ten-Ten International Net of Southern California. All you have to do is collect 10 different Ten-Ten numbers if you are in the USA and 5 if you are out of the USA. You send the log information only, no QSLs needed, to the manager in charge of your call area along with a nominal fee," he went on to explain. "You will get your own Ten-Ten number along with a certificate, suitable for framing, plus quarterly newsletters. We are all having a ball and at the same time keeping ten alive and saving our band from being taken over by the CBers," he raved.

He explained that many of the chapters issue their own certificates for working a certain amount of their certificate holders. The Yodar Kritch is the name of a certificate issued by the Maryland, Washington D. C. chapter. In fact, its chapter head is Jim Hart WA3NCQ, so they also issue The SweetHART certificate for working five members. The LIARS stands for the Long Island Amateur Radio Service, a chapter serving the New York City, New Jersey metropolitan area. You can get more information by signing into their Thursday evening net on 28.620 MHz at 8 pm local time.

I apologized for my ignorance and asked just how many are now involved in this new aspect of amateur radio and isn't it pretty expensive? "We are well over the 9000 mark," he replied, "and the certificates are no more than one dollar. In fact, some are free. You don't have to go certificate-hunting if you're not interested, just collect Ten-Ten numbers. Bars, plaques and awards are issued for reaching different plateaus of achievements. Worked All States Ten-Ten awards are even issued. For this one you do need QSL confirmations. You can become a VIP in the Ten-Ten organization by collecting 500 numbers. 1000 different contacts qualify you for a plaque award. You can work up to these levels by submitting a list of each 100 you work, for which you receive a bar."

"Sounds mighty complicated," I said. "Did you hire a private secretary to do your paperwork?"

"On the contrary," he shot back, "it's pretty simple if you can keep an up-to-date card file and use a separate log for ten. It's like an eternal contest, worked on at your own pace. You will find us to be a group of very friendly chaps, all willing to help. None of the hanky-panky that you hear on some of the other bands."

"To each his own," I replied. "2m FM here I come! What is your Ten-Ten number? Just for my log, you understand."

As you have probably guessed, over two years have passed and I never did get on 2m FM. Two months after that fateful evening, I was already hooked with my own Ten-Ten number of 9732. I have collected many numbers since and have had the most enjoyable contacts in my twenty-two years of hamming. Over 13,000 numbers have been issued and it shows no sign of stopping. For twenty years I could have been considered a certificate haters club member. Today, I am the holder of many unique certificates issued by the Ten-Ten chapters. They would have to be seen to be appreciated. One of the certificates, The Raggedy Ann and Andy, is issued by Worth Gruelle K4VM. Worth, a renowned artist, the son of Johnny Gruelle who invented and originated the characters, issues the certificate in memoriam to his father. The different certificates issued now number over 50. They are too numerous to mention and many hold interesting stories behind their origination.

Propagationwise, ten meters appears to be the twilight zone of HF and VHF characteristics. It's fascinating to observe the effects of backscatter and tropospheric bending. Sporadic E propagation found on ten seldom appears on fifteen meters. It is a rarity on six and will reach a maximum of maybe 70 MHz. Freak conditions, at times, will cause it to appear higher.

Ten meter beacons are being transmitted from almost all continents of the globe as a guide to conditions. This is evidence enough to show the increasingly wide interest being shown on this band.

It is ironical to hear so many newcomers to this band comment that they haven't been on ten for years. They thought it was dead. Many skip contacts are being made and at times when fifteen and twenty are dead. True enough, if no one went on, it would appear to be dead. How surprised many would be if they tuned their receivers to ten.

Antennas need not be cumbersome. When conditions permit, many long haul contacts can be made much easier on this band with simpler antennas and lower power then is needed on the other lower frequency bands. QRM problems appear less frequently due to the huge frequency spread.

I want to thank Mike WA4BNU and Ron WB4ASV both of Birmingham, Alabama, the home of the All American Cities chapter, for taking the time to initiate me into Ten-Tenning. My appreciation also goes to the Long Island Amateur Radio Service (LIARS) and its chapter heads past and present, Rich WB2MAN, Jack W2KDI, and all of their officers and members for their dedication to keep ten alive, along with many others who all share in using ten and enjoying it. ■

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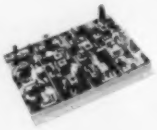

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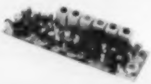

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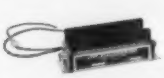

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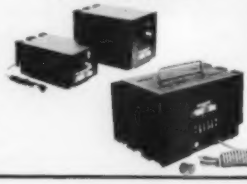

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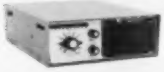
PS3012	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/foldback current limiting and over voltage protection, wired and tested	239.95

REPEATERS

RPT28 Kit	repeater – 10 meter	TBA
RPT28	repeater – 10 meter, wired & tested	TBA
RPT50 Kit	repeater – 6 meter	TBA
RPT50	repeater – 6 meter, wired & tested	TBA
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95
RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
DPLX144	2 meter, 600 KHz spaced duplexer, wired and tuned to frequency	399.95
DPLX220	220 MHz duplexer, wired and tuned to frequency	399.95

TRANSCEIVERS

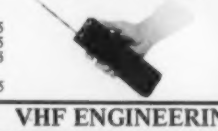


TRX 144 Kit	case and all components to build 15 watt 10 channel scanning 2 meter transceiver (less mike and crystals)	219.95
TRX 220 Kit	same as above except for 220 MHz	219.95
TRX 432 Kit	same as above except 10 watt and 432MHz	254.95

SYNTHESIZERS

SYN II Kit	2 meter synthesizer, transmit offsets programmable from 100 KHz - 10 MHz, (Mars offsets with optional adapters)	169.95
SYN II	same as above, wired and tested	239.95

WALKIE TALKIES



HT 144B Kit.	2 meter, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
NICAD	battery charger	5.95
Rubber Duck	2 meter, with male BNC connector	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/ diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD-3 Kit	UHF version of CD-1 deck, needed for 432 multi-channel operations	12.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority.	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
Microphone	2,000 ohm dynamic mike with P.T.T. and coil cord	9.95

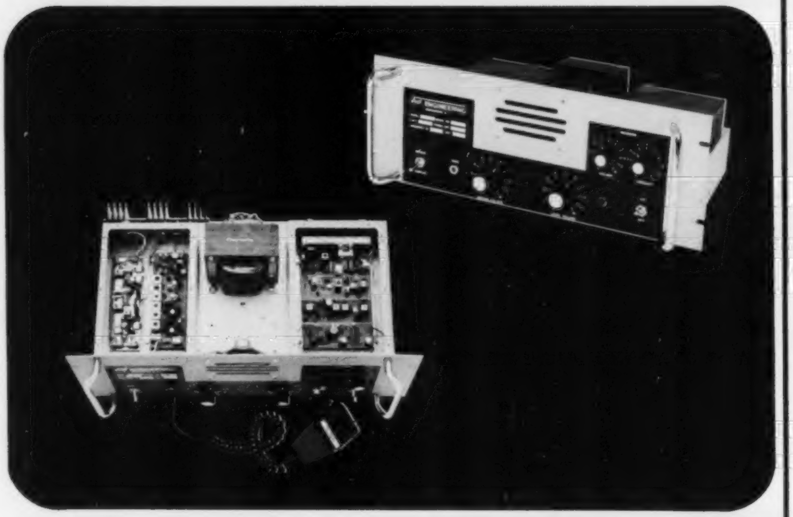
master charge

VHF ENGINEERING
DIVISION OF BROWNIAN ELECTRONICS CORP.
320 WATER ST. / BINGHAMTON, N.Y. 13901 / Phone 607-723-9574

BANKAMERICARD

IF YOU ARE ON 144, 220 OR 432 AND HAVE WORKED A REPEATER...

It was probably this one.



The RPT 144B, RPT 220B and RPT 432 are self-contained — all solid state machines. Conservatively rated, high quality components, assures EXCELLENT RELIABILITY. Careful consideration has been given to both interfacing and control flexibility.

RPT 144B or RPT 220B Kit	**$465.96**
RPT 432B Kit	**515.95**
RPT 144B or RPT 220B factory wired and tested	**695.95**
RPT 432B factory wired and tested	**795.95**
RPT 50B soon to be announced	**N.A.**
RPT 28B soon to be announced	**N.A.**

WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

Vhf engineering
-600
+600
SIMPLEX
A
B
C
147.990
synthesizer II

The Synthesizer II is a two meter frequency synthesizer.
Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 100 KHz to 10 MHz. No additional components are necessary!

Kit . . . .$169.95 Wired and tested $239.95

Export prices slightly higher.

Available at these dealers:

CALIFORNIA
- C & A Electronic Enterprises, Carson, CA
- Electronic Enterprises, Rio Linda, CA
- SON Electric, Fresno, CA
- Tele-Com Electronics, San Jose, CA
- Westcom, San Marcos, CA
- ZacKit Corporation, Vallejo, CA

COLORADO
- Listening Post & Electromagnetics, Durango, CO
- Communication Specialties, Aurora, CO

FLORIDA
- Amateur Wholesale Elec's., Miami, FL
- West Indies Sales Co., Ltd., Miami FL

ILLINOIS
- Klaus Radio, Inc., Peoria, IL
- Spectronics, Inc., Oak Park, IL

INDIANA
- Communication Systems, Bourbon, In

KENTUCKY
- Cohoon Amateur Supply, Trenton, KT

LOUISIANA
- Frank L. Beier Radio, Inc., New Orleans, LA

MASSACHUSETTS
- Tufts Radio Electronics, Medford, MA

MICHIGAN
- Harry G. Crofts, Northville, MI
- Adams Distributing Co., Detroit, MI
- Radio Supply & Engineering, Detroit, MI

MISSISSIPPI
- Communications Services, Philadelphia, MS

MISSOURI
- Alpha Electronic Labs, Columbia, MO

NEVADA
- Vegas Radio, Las Vegas, NV

NEW YORK
- Barry Electronics, New York, NY
- CFP Enterprises, Horseheads, NY
- COSYSCO, Inc., Sodus, NY
- Delmar Electronics, W. Babylon, L.I., NY
- Loffler Electronics, Ogdensburg, NY
- VHF Communications, Jamestown, NY
- W. Spindler Elec. Service, Rome, NY

NORTH CAROLINA
- Vickers Electronics, Durham, NC

NORTH DAKOTA
- CDS Electronics, Emerado, ND

OKLAHOMA
- Derrick Electronics, Inc., Broken Arrow, OK
- Radio Store, Inc., Oklahoma City, OK

SOUTH DAKOTA
- Burghardt Amateur Center, Watertown, SD

TEXAS
- Teco Electronics, Garland, TX

VIRGINIA
- Radio Communications Co., Roanoke, VA

WASHINGTON
- A-B-C Communications, Seattle, WA

WEST VIRGINIA
- Communication Systems Co., Ripley, WV

WISCONSIN
- Amateur Electronic Supply, Milwaukee, WI
- Communications Elec's., Fond du Lac, WI

WYOMING
- Rule Communications, Laramie, WY

CANADA
- Ayre's Ltd., St. Johns, Nfld. A1B 1W3
- Traeger Distributors Ltd., Canada V7J1K4

PUERTO RICO
- Edison Electronics, Inc., Santurce, PR

Vhf engineering

DIVISION OF BROWNIAN ELECTRONICS CORP.

320 WATER ST.
BINGHAMTON, N.Y. 13901 • 607-723-9574

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BANKAMERICARD

New Products

HEATHKIT HW-2036 SYNTHESIZED 2 METER TRANSCEIVER

Do you do a slow burn every time your old buddy comes on the air and brags about his brand new synthesized rig? Does he rub in the fact that what he paid for it roughly equals a month's pay for you? Do you get the old here-we-go-again feeling every time a new repeater comes on in your area and you spring for a new set of rocks? Well, there's a solution. For $269.95 you can get yourself a fully synthesized 2 meter rig with specs and features equaling radios that cost over twice as much.

I'm talking about the *new* Heathkit 2036. I have to stress the word new since in all probability many operators will remember what happened in 1975 with the 2026. To refresh your memory, the 2026 had a spur problem which was difficult to correct without a spectrum analyzer, something you just don't find in every shack. Heath, however, set things right by doing something that is extremely rare in the merchandising business — they took back the rigs, refunded money in full, and went back to the old drawing board.

After a year of redesigning, the successor has arrived. The HW-2036 has solved the problems. Heath says the spurs are now down 70 dB within 20 MHz of the carrier and their spectrum analyzer photos back this up. So it seems that now we can operate without worrying that every repeater within range will be set off.

The HW-2036 has the solid look and feel that hams have come to expect from Heath amateur equipment. The unit weighs 6½ pounds and features the usual turquoise blue finish. The folks at Heath have provided the multi-packaging of their kits with a large number of parts. Six sub-packs keep all those little parts well separated until they are needed. The manual hefts out at 160 pages and is in keeping with the Heath tradition of step by step crystal-clear directions. A separate fold-out section contains all the pictorials so they can be conveniently mounted over the work area for easy perusal.

The HW-2036 is definitely not a quickly-assembled one evening kit. There's a large number of parts and quite a few steps to assembly. Five circuit boards are involved. They're interconnected with a pre-assembled wiring harness. Access to the boards for the big step of alignment is excellent. There are eight sections involved for a total of nearly 100 alignment steps. For this, you need a VTVM or high-impedance VOM, as well as a receiver that tunes WWV. Even better, use a frequency counter that reaches 150 MHz. Although the steps are quite time-consuming, alignment isn't a terribly complicated procedure. Any 2 MHz segment of the 2 meter band can be selected.

On a weekend trip, I worked a number of repeaters in the New England area. Just about everyone I talked with commented on the clean and crisp audio output. Remarks like, "It must be a Heath" were common. The rig features a 10 Watt output, which was adequate for all but the fringe areas. I'm a bit spoiled anyway since my old rig ran 45 Watts. My impression is that one can get along just fine without an external amplifier, considering the proliferation of repeaters.

The economy-size illuminated meter is a joy to use. It shows both received signal strength and relative rf output. A bright green LED situated next to the meter pops on to show there is a signal being received.

A red LED labeled "Synth Lock" lets you know when the synthesizer is not locked to frequency. If you don't notice it and the unlocked condition lasts for more than one-half second, the transmitter is automatically disabled by a safety circuit to insure that you won't accidentally operate outside the band. Another fail-safe built into the HW-2036 disables the transmitter if you dial above 147.995 or below 144.00. If you're into MARS or CAP, don't despair, since this can be defeated by the simple act of removing a jumper on one of the circuit boards.

I found it helpful to put a small hooded light over the channel selector switches so I could more easily set them at night.

Heath told me that they had been having a few complaints about audio with the HW-202. Checking into them, they found that some customers had put non-standard mikes on the units. To eliminate this problem on the HW-2036, they made the mike non-detachable.

I've always wondered why Heath mikes are white. On a dark New Hampshire night, I found out. Having no mike clip on the dashboard, I have to lay the mike on the dark colored upholstery. This requires a good deal of groping. With the shiny white mike, my problem was solved.

The HW-2036 can be ordered with either the standard mike for $269.95 or with Heath's Micoder featuring a built-in Touchtone pad for $299.95. That's a savings of 20 bucks over the Micoder alone.

Adding to the list of built-in features is a subaudible tone encoder. Three switchable tones can be set during alignment in the 70-200 Hz range.

A logical accessory for the HW-2036 is the HWA-2036-3 power supply. Selling for $32.95, this easy one-evening project supplies 13.8 V dc at up to 2.7 Amps. It features 1% regulation and 0.1% ripple.

For those who are interested in specs, here are a few for the HW-2036. The receiver sensitivity is 0.5 uV for 12 dB SINAD, which comes out to 15 dB of quieting. Audio output is typically two Watts. I-f rejection is greater than -80 dB. while trying various repeaters, I found a very noticeable birdie at 147.00 MHz. While puzzling about this problem, an early-morning call from Heath shed light on what happened. It seems the first production run of the HW-2036 had a bum FET in the synthesizer board which resulted in that birdie. No units with this were shipped to customers. Heath assured me that the inclusion of the correct part would eliminate the birdie problem completely.

The transmitter is capable of taking a 100% duty cycle into an infinite VSWR. Offset crystals are supplied for plus and minus 600 kHz with provision for one extra. Current consumption is 700 mA on receive and 2.6 Amps on transmit.

The HW-2036 is a pleasure to build and to use. You'll have to look pretty far to find all these features for a price of $269.95. It's by far the lowest cost synthesized 2 meter rig on the market and is sure to find an immediate niche. If you want to stop collecting rocks and the piggy bank isn't full enough for one of the big ones, this is sure to be the rig for you. *Heath Company, Benton Harbor MI 49022.*

Stan Miastkowski WA1UMV
Associate Editor

THE VHF ENGINEERING SYN II SYNTHESIZER

VHF Engineering of Binghamton NY has announced their new SYN II synthesizer, a high quality synthesizer designed for use into virtually all two meter rigs available on the market today.

The VHF Engineering SYN II synthesizer is designed to operate over a frequency range of 140 to 149.995 MHz in 5 kHz steps, and is compatible with two meter equipment that uses transmit crystals in the 6, 8, 12, or 18 MHz range and receive crystals in the 15 or 45 MHz range. The SYN II synthesizer may be used with either FM or phase modulated transmitters and may be operated with either mobile or base transceivers. The SYN II synthesizer features unique i-f programming which permits the unit to be used with receivers having i-fs in the range of 100 kHz to 30 MHz. Detailed programming instructions are given in the construction manual so that the builder may select the standard 10.7 MHz i-f or any other i-f frequency in the permissible range. This feature permits use of the SYN II with older commercial equipment as well as currently available two meter units. Standard repeater offsets of +600 kHz, -600 kHz are provided along with 3 user selectable offsets in 100 kHz steps. This feature permits the user to operate standard repeaters

HEATHKIT
AC POWER SUPPLY

Vhf engineering
SIMPLEX
-600
+600
A
B
C
1 4 7.9 9 0
synthesizer II

as well as repeaters with unique offsets. A modification kit is available for MARS and CAP offsets.

The VHF Engineering SYN II synthesizer kit consists of high quality epoxy glass circuit boards, computer grade components, thumbwheel switches, stylized cabinet, and a detailed construction manual. The kit is complete and requires no additional components. The price of the kit is $169.95; wired and tested $239.95; programmed to your equipment $249.95. *VHF Engineering, 320 Water St., Binghamton NY 13902.*

THE KLM ECHO 70
432 MHZ SSB/CW TRANSCEIVER

If you have longed to explore the world of 432 MHz, Echo 70 may be the answer. Heretofore, 432 equipment for SSB has been mostly a matter of homebuilt type equipment. Thanks, in part, to the popularity of AMSAT's OSCAR satellite, KLM has filled a void for a reliable compact piece of gear for the OSCAR up-link. The KLM Echo 70 is imported by KLM from Japan where it is known as the "Liner Four Thirty."

If OSCAR is not your bag, then maybe 432 DX will interest you. With those super KLM antennas there should be no problem making sufficient contacts on the band to keep up your interest. We are fortunate in the South Jersey area to be within range of a good deal of activity from the New York-New England area and from across the river in the Philadelphia area.

One can't help but be impressed by the Echo 70; from the time the packaging is removed, it is a physically attractive and sturdy-looking piece of gear with the controls well laid out and convenient to operate. The unit comes complete with a dynamic mike, mounting bracket and dc cord, and is ready for mobile operation as is or can be set up in the shack with the addition of a regulated 12 V dc supply good for about 5 Amps maximum. When used in this manner I would strongly recommend the use of KLM's model 432-16-LB 16 element antenna which sports a gain of 15 dB and is rather compact with its 12 ft. boom length. Be sure to use low loss, jacketed or hard line coax for those extra long runs up the tower. The *VHF Handbook* gives 5 dB attenuation per hundred feet for regular RG-8/U at 420 MHz.

Now let's take a look at how the Echo 70 operates. The unit covers two segments of the band: 432.00 to 432.480 MHz and 435.00 to 435.480 MHz. These ranges are switch selected from the rear panel. Having selected the operating range, the tuning knob on the front panel features a direct readout channel display (similar to an FM rig) which ranges in steps from 432.01 for channel 1 to 432.47 for channel 48, or 435.01 to 435.47, and a VXO control with 20 kHz divisions for total coverage between each channel.

The receiver has an RIT control which can be switched in or out of the circuit for additional excursions of plus or minus 2 kHz from the transmit frequency. An effective noise blanker may be switched in by means of a front panel push-button. Upper or lower sideband is also push-button selected from the front panel. The power, volume and squelch controls are concentrically mounted in the upper right corner of the front panel. An unusual and convenient feature is built in to the front panel when the VXO is in the off position. This feature is called an "Auto Watch," which allows the receiving frequency of each channel to be swept automatically. The auto watcher will not respond to weak signals but will detect, by a beat note, stronger signals within the range of each channel, which after they are detected can be "tweaked in" with the VXO.

Reports of an excellent sounding signal have resulted on both SSB and CW with power output in the ten Watt range, giving excellent coverage with a good antenna. Solid state amplifiers are available should you choose more power.

Although not measured, the receiver sensitivity seems excellent and well within the 0.5 uV for 10 dB s/n claimed by KLM. The quality of the small internal speaker is fine and provides sufficient audio output.

Additional operating controls include a mike gain (accessible from the right side panel) and rear panel controls for SSB-CW, frequency range, key jack, external VFO switch and VFO input jack, a relay switching control and external speaker jack. The mobile mounting bracket doubles as a fine stand for the operating table.

To be fair, any equipment report should include the negative as well as positive factors under review. This is an honestly difficult task but nonetheless a few items were uncovered. My major "gripe" is the oddball CW jack on the rear panel for which KLM did not provide a plug or adapter. For those of you who care to use it (I do not, except for contest work), a VOX circuit would be a handy addition or option.

I think the first sentence in the Echo 70 operating manual is an appropriate closing line for this article. "The unit is the very first 432 MHz band SSB transceiver that has ever been manufactured in the world. Nevertheless, it is a compact and cozy piece of equipment with prominent performance." *KLM Electronics, 17025 Laurel Road, Morgan Hill CA 95037.*

Dan Kernan WA2KOK
Vincentown NJ

VHF ENGINEERING
2M TRANSCEIVER

It started with my desire to build a 2m mobile rig that wouldn't take up much space. After running a converted GE mobile phone rig, which took up most of the storage area in the cab of my pickup, it was obvious that the answer was to go solid state. VHF Engineering seemed a logical choice, since I could mix and match their components and custom design my own system.

A phone call to Tufts Radio in Medford MA brought a 2 meter transmitter strip (TX-144). I decided to start with the transmitter because I wanted to get a look at the way VHF Engineering products went together before I acquired the remaining components for my transceiver. The kit was easy to assemble, with all PC boards well laid out, and a sensible set of instructions. Construction took two evenings, and with a #51 light bulb, talking across town was a snap. With a 19" ground plane the Concord NH repeater, some 30 miles away, yielded good to excellent signal reports. The one Watt transmitter strip proved to be quite a performer, with several stations reporting good audio.

All doubts about VHF Engineering cast aside, it was time to order a receiver. Again a call to Tufts . . . and again prompt service. The RX-144D receiver, like the matching transmitter, was easy to build, and provided almost instant satisfaction. Assembly time was about double, including alignment. The major change in the 144D over previous VHF Engineering 2 meter receivers is the elimination of variable capacitors for alignment purposes. Instead, VHF has switched to slug tuned coils, and the results are encouraging. Aside from the ease of alignment, the coils are bound to last longer. Noise is reduced, since dirt can't get into coils as it can into capacitors . . . plus there's the question of corrosion, since silver plated capacitors are bound to detune after an extended period of all-weather use. Here in New Hampshire, with our wide changes in temperature, it's best not to take any chances, and I'll take coils over capacitors under those conditions anytime.

With receiver and transmitter up and running, the next question was an enclosure. After searching through everything I had around, it became obvious I would have to buy some-

KLM ELECTRONICS
AUTO WATCHER
LSB
N.B.
USB
OFF
VXO
ECHO 70 cm
432 MHz SSB/CW TRANSCEIVER
VXO
RIT
OFF
SQ
VOL & PWR

thing. Then VHF Engineering announced production of a cabinet kit, with relay knobs, speakers, volume and squelch controls. I couldn't resist.

Take a look at VHF Engineering's product line and it's easy to see why you can custom design your own rig. Scanning decks, accessory filters, amplifiers, even synthesizers are available. I opted for a 10 channel scanning deck and 1x25 Watt amplifier. In the VHF Engineering case it all fit like a glove. Really nice layout, with lots of room for even the most all-thumbs constructor.

On-the-air operation is actually more fun than building the kits (although I had my doubts while building, since I kept coming up with more accessories). Reports have been most satisfying, and the pride of knowing I not only constructed the gear, but custom designed it as well, doubles the fun.

I've already started work on my 432 rig, and 220 isn't far behind. By the way, if economics is any consideration, my entire 25 Watt 2 meter mobile ended up costing less than $225. Can you beat that? *VHF Engineering, 320 Water Street, Binghamton NY 13901.*

Bob Main W1ZAW
Hillsborough NH

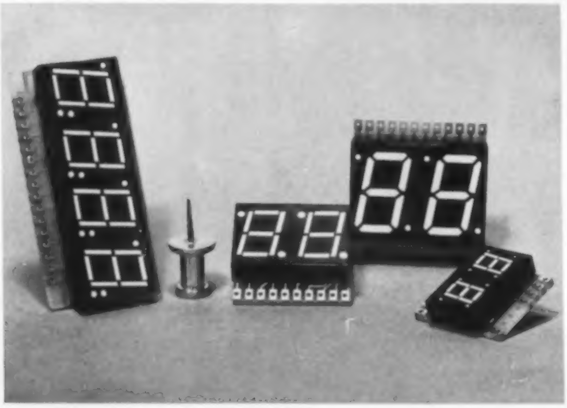
NEW MULTI-DIGIT LED NUMERIC DISPLAYS FROM NATIONAL SEMICONDUCTOR

A new series of light emitting diode display numerics are now being manufactured by National Semiconductor Corporation, according to Bob Santos, Marketing Director for Optoelectronic Products. This series of multi-digit GaAsP reflective displays represents the latest in design advances in 0.3, 0.5 and 0.7 inch formats, Mr. Santos said. "They provide the designer with an effective, easy to implement answer to the need for an inexpensive large numeric display for use in a wide range of applications."

Basically 2 digit and 4 digit displays, the units can be stacked on end for uses that require additional digits. (The 2 digit displays are known as the "NSN" series, and the 4 digit displays are the "NSB" series.) When combined with the options for overflow, polarity and other indications, virtually all display requirements can be satisfied. Both the common anode and common cathode forms are available with direct drive and multiplex versions, providing a great deal of versatility to the designer. Printed circuit board type terminals on the edges of the display are used for electrical contact.

The optical design of this display series creates a distinct, easy to read display with a wide viewing angle, as well as excellent on-off contrast and segment uniformity, making these units suitable for use in test and measurement equipment, consumer products, instrumentation, industrial controls, digital instruments, desk top calculators, clocks, TV channel indicators, and other applications. The series features a typical digit light intensity at 10 mA of 1.6 mcd.

Pricing per digit in lots of 100 pieces is $1.80 for the 0.3 inch, $1.90 for the 0.5 inch, and $2.00 for the 0.7 inch sizes. *National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara CA 95051.*

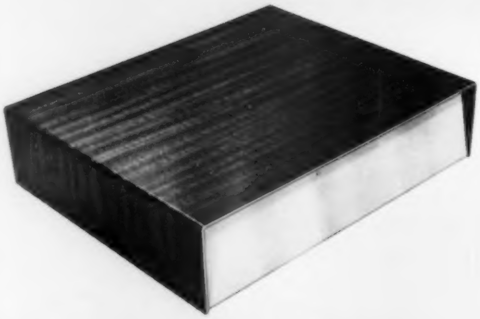


CASES ENHANCE CUSTOM-DESIGNED INSTRUMENTS

A new line of economical enclosures, in two sizes and numerous attractive colors and finishes, gives desk-top instruments an appearance contemporary with sophisticated electronic components and systems. Designated "Cono-Cases" by Vector Electronic Company, the WA series enclosures incorporate a ten degree sloped front panel and an optional smoked plastic facing for behind panel indicators. A recessed rear panel protects input/output connectors.

The enclosures, assembled from two interlinked channels, allow easy access to circuits, accessories and wiring. The lower section forms a chassis integrated with front and rear panels. Elongated holes in the bottom and rear panel provide superior convection cooling. The upper section serves as top and side panels. The WA1 enclosures are 11 inches wide by 8 inches deep by 4 inches high, giving 307 cubic inches of circuit space.

The WA2 enclosures are 14 inches wide by 11 inches deep by 4 inches high, providing a 560 cubic inch working volume. Construction of 0.062 inch (14 gauge) aluminum insures adequate support for transformers, heat sinks and other heavy components.



Cono-Cases are available with clear anodize satin finish, or with blue or walnut grained vinyl on the cover. Other colors available in anodize, vinyl or paint on request.

A full line of circuit boards and packaging accessories supports the enclosure line.

The WA series enclosures are priced from $12.95 to $19.70, depending on model and finish. They are available off-the-shelf from Vector and will be available through the firm's distributors throughout the United States and Canada.

Vector is a major manufacturer of sockets, terminals, connectors, printed circuit boards, card cages, enclosures, and complete packaging systems. *Vector Electronic Company, 12460 Gladstone Avenue, Sylmar CA 91342.*

ENGINEERING SPECIALTIES SYNTHACODER 22

What the heck is a Synthacoder? And why does every Icom 22S owner need one? The answers lie in the design of Icom's new radio, a diode matrix synthesizer which puts an end to crystals forever. (See New Products, Holiday '76 *73*.) Synthacoder is obviously a combination of synthesizer and encoder, and encoding is just what the device does. It makes the 22S a lot more fun to use, but still keeps the price tag low.

Using the Synthacoder, you can put the 22S on any common or 15 kHz simplex or repeater pair with a flick of four thumbwheel switches. Program the 22S for 21 channels of your choice using the diode matrix, and plug the Synthacoder into number 22. A trip into unknown repeater territory becomes a snap, provided your *73 Repeater Atlas* is handy.

Fact is that due to space limitations on the diode matrix, the 22S cannot be programmed for every standard repeater pair. You can cover non-split channels from 146.01 through 146.37 and up from 147.00 to 147.24 MHz before running out of channels, but that leaves five standard pairs unavailable, not to mention simplex and splitter pairs. The solution is obviously an outboard encoder.

Many folks think they can outboard the 22S with a single ROM or even a few thumbwheel switches. You can, but to figure out what channel you're on takes enough charts and calculations to make the average weekend sports car rallyist cringe.

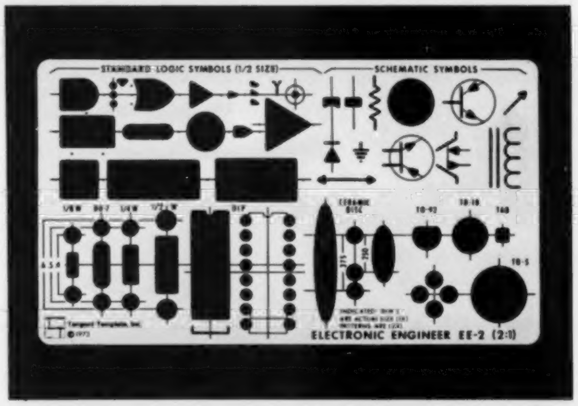
The Synthacoder allows *direct* readout of frequency, through a complex system using CMOS bipolar logic. The manufacturer won't say much more than that about his design and I suppose his reluctance is understandable. The competition is reportedly fierce to produce devices like the Synthacoder, with more than the 22S in mind. The smart money says Icom's idea will soon be appearing in other rigs, eventually eliminating the need for crystals. If diode matrix synthesizers do become the VHF economy rage, the Synthacoder will have a definite edge on the rest of the pack.

One big reason for Engineering Specialties leadership is price. Complete with wiring harness, hardware and fully assembled, the Synthacoder retails for $74.95. That puts the cost of an outboard programmed IC-22S under $320. Two hundred dollars more would be required just to equal the Icom receiver and super frequency flexibility.

Installation is quite simple, using the 9 pin accessory socket built into the 22S, to bring the Synthacoder's encoding lines into the Icom's diode matrix. Power is supplied by installing two pins in the standard 12 volt socket. (Icom conveniently left the two pins vacant.) The Synthacoder then is easily connected and disconnected from the 22S, and mounted with strips of velcro attached to the Icom mounting bracket. The unit is super compact, with a single PC board, and dimensions of 3¾" wide by 1½" high by 6" deep. It weighs less than 6 ounces and is packaged in a brushed and anodized aluminum case.

Dialing up frequencies with the Synthacoder is easy, although seeing the thumbwheels in the dark is impossible. (Engineering Specialties is working on an illumination kit, but I'm confident most hams will devise some type of lighting system of their own.) Otherwise there isn't a glitch to be found with the unit. It's very easy to count up and down without taking your eyes off the road, because the thumbwheels have a very positive feel.

INVALID
CODE
Synthacoder 22


STANDARD LOGIC SYMBOLS (1/2 SIZE)
SCHEMATIC SYMBOLS
DIP
ELECTRONIC ENGINEER EE-2 (2:1)

The Synthacoder will not allow non-15 kHz frequencies, which the Icom will reject anyway. Instead the unit automatically disables the transmitter and turns on a bright red LED warning lamp labeled "Invalid Code" if you hit one of those non-standard frequencies.

Last month, after reviewing the 22S, I was left with the impression I'd be hard pressed to find 22 different channels to program into the Icom's diode matrix. I was wrong. After a trip into the New York City area with the 22S and matching Synthacoder, I vowed never to leave New Hampshire without the encoder. Not one repeater was out of my reach. And I'd successfully avoided the $500 dollar club in trying to put together a flexible, synthesized 2 meter mobile. And with the money I saved it was easy to finance a linear amplifier. *Engineering Specialties, PO Box 2233, 1247 Commercial Avenue, Oxnard CA 93030.*

Warren Elly WA1GUD
Associate Editor

NEW GENAVE VHF TRANSCEIVER

General Aviation Electronics, Inc. (GENAVE) of Indianapolis, Indiana, has introduced a new 25 Watt, high band transceiver. The unit comes in two models — the GMT-125 and the GMT-225.

The GMT-125 is called the "economy workhorse" of the GENAVE line. Modestly priced at $345, the transceiver will operate between 143.9 and 173.4 MHz.

The GMT-125 is a one channel transceiver and includes a 4 pole monolithic crystal filter. The inclusion of the crystal filter means that in most areas there is no adjacent channel interference. An 8 pole monolithic crystal filter is also available for those high density areas. A built-in heat sink enables the unit to operate longer and more effectively. Included with the GMT-125 is a captive microphone.

The GMT-225 is the deluxe 25 Watt model. The transceiver has all of the same fine features as the GMT-125, including a 4 pole monolithic crystal filter and built-in heat sink. The GMT-225 does include the addition of another channel, making it a two channel transceiver, and substitutes a plug-in microphone for the captive microphone. The GMT-225 is priced at $360.

Included with both the GMT-125 and the GMT-225 are microphone, microphone clip, dc power cord and mounting bracket. Weighing only 6 lbs., and operating on 13.75 V dc, the units are easily installed anywhere.

The subaudible tone squelch is one of the most advantageous accessories for the GMT-125 and the GMT-225. The tone squelch allows your receiver to be activated only in response to calls placed within your own system. No distractions by everyone else's transmissions!

Other accessories available for both units include portable power pack (allowing portable operation), external speaker and 12 Watt PA horn.

Also available are antennas for trunk lip mount, magnetic mount, and drill through mount. *General Aviation Electronics, 4141 Kingman Drive, Indianapolis IN 46226.*

THREE FUNCTION TEMPLATE SPEEDS CIRCUIT DESIGN

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The template is designed expressly for use by electronics engineers, circuit designers, technicians and draftsmen. The Electronics Engineer template is available with 1:1, 2:1 and 4:1 component patterns. EE-1 (1:1), $5.00; EE-2 (2:1), $5.50; and EE-4 (4:1), $7.50. *Tangent Template, Inc., P.O. Box 20704, San Diego CA 92120.*

NEW CATALOG AVAILABLE

Hamtronics, Inc. announces publication of a new catalog, which is available on request. This new edition features a new miniature VHF receiver preamplifier, a receiver multicoupler allowing the use of two receivers on a single antenna, and a low cost FM signal generator. Previous products include VHF and UHF FM receivers and transmitters in kit form and various adapters for use with VHF and UHF equipment, such as scanner adapters, multichannel adapters, and a full line of preamps. This new 16 page catalog is yours in exchange for a self-addressed stamped envelope. *Hamtronics, Inc., 182 Belmont Road, Rochester NY 14612.*

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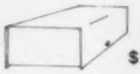

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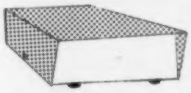

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7426	.27
7427	.19
7432	.34
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7438	.39
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- - microwave repeater control

Each repeater owner has his own favorite way to control his repeater, be it an on-site system with an on-off switch or the most elaborate of UHF radio systems. In remote control systems, the two most popular today are UHF radio remote and telephone remote. Both have drawbacks in an area like Los Angeles. First, the majority of our repeaters are located atop rather large mountains that can be a toll call away, and calling your system to activate one of your many remote functions can become quite expensive. For that reason, UHF remote control has become very popular out here, because there is a one shot investment and that's it. The drawbacks though, can be twofold. In Los Angeles there is virtually no unused spectrum available on the 450 band and it has been that way for many years. Obtaining a clear spot for a control link can be a job and a half. So, if a system already has an allocation, why change? Security and dependability – these are the key reasons for Burt Weiner K6OQK's decision to install a point-to-point microwave control system from his home in the San Fernando Valley (fondly referred to as "Burt's Pumpkin Patch") to his repeater in the KPFK transmitter site on Mt. Wilson.

For many years Burt has alternately controlled WR6ABE on telco lines and UHF, but has encountered the drawbacks previously discussed. Finally, upon acquiring some microwave equipment, he decided to make the big break from tradition and install the equipment as control for his system. Another reason was the pride he takes in the overall quality of the system itself. To listen on the output and then alternately switch to the input, one will note that many of the repeated signals out of ABE sound much better than its receiver is hearing. A look at the repeater itself will easily explain the reason. While the receiver and transmitter are quite standard early vintage Motorola, the equipment between them is state of the art broadcast quality. Burt, a broadcast engineer by profession, has taken a lot of care with the audio and carefully processes every word the receiver hears before the transmitter gets it. His technological wizardry can make even the raunchiest signal sound fairly passable. Since ABE's site also functions as a remote for the weekly "Mt. Wilson Repeater Assn. Amateur News QST Bulletin" and the audio quality via the telco lines was nothing to brag about (and since he was quite familiar with the improved quality that could be had by feeding the "News Service" to the transmitter via a microwave link), the decision to implement was made.

The accompanying photo taken on Mt. Wilson at the "Pumpkin Patch" tells part of the story. Burt and his compatriots have the ability to make even the hardest job a labor of love . . . you have to love what you are doing to truck a 200 lb. dish up a 5000' plus mountain, install it, and then go home and climb your 70' tower with another 200 lb. dish.

While still in the experimental stages, eventually WR6ABE will be on a full time microwave control system with limitless capabilities. At any rate, it is at least another first for southland open repeaters as far as we know. ■

Weather Satellite Simulator

- - do-it-yourself satellite?

David J. Brown W9CGI
RR 5, Box 39
Noblesville IN 46060

This satellite may never fly, but it does speak exactly the same language as the weather satellites we presently have in orbit. There are a number of articles already available describing monitors for copying these transmissions.[1] Some are complete monitors and others describe how to modify your SSTV monitor to add this feature for a very small fee. These articles also describe the different set of standards used by this service, so I will touch on them only briefly, and only as they apply to this project.

The project is an adapter that goes with another item by Dr. Robert Suding W0LMD in the July 1975 *73 Magazine*, page 98. This article described a generator of accurate audio tones using a crystal timebase, and then TTL ICs to divide down to the required audio. By using a very accurate and reliable (and quite inexpensive) generator like this to feed my adapter, you end up with a gray scale generator for use in setting up SSTV monitors to very accurately decode and display weather pictures.

The standards used by these satellites very briefly are: 1. The transmission to Earth is an FM modulated (approximately 10 kHz deviation) carrier in the 135 MHz region. 2. The FM modulation is a 2400 Hz tone. This 2400 Hz tone is AM modulated giving picture and sync information that is equal to the instantaneous percentage of modulation – 0% is black, 80% is white, and 100% is sync. 3. The sync is sent just before each horizontal line for 12.5 ms (APT-satellite). 4. The horizontal rate is 4 Hz or 1 line every 250 ms (APT). 5. The total picture length or vertical scan is 200 seconds for 800 lines resolution (APT). 6. The aspect ratio is 1:1 just as in SSTV transmissions. The articles describe exact times, days, frequencies, and information required to copy pictures and are highly recommended reading for those intending to try. These standards as they apply to this adapter concern only the horizontal, vertical, and sync information and how they each relate to the percent of modulation and its use here.

Where to Start

I believe someone once said that for rabbit stew you first need a rabbit! In this case that would be to build the W0LMD generator. Other stable sources could be used, but this unit is so versatile it is more than worth the extra effort. One addition is suggested and can be included in the original generator if you choose, by using the 12th position of the rotary switch marked "frequency selector." This would be a good addition even if you don't build the adapter, since it gives you a very good source of 2400 Hz used for the weather satellites. If you have an SSTV monitor, the modifications to make it work in "satellite mode" are so few, and the addition of a 2400 Hz position to the generator so easy, that it seems silly to do without either. Further, the 2400 Hz tone is also very close to the bandpass edge for present SSB filters (2.5 kHz) and should prove useful for things other than satellites.

The modifications required to the W0LMD generator are as follows: 1. Add one more 7430 TTL IC to the parts required, and wire it into the circuit for +5 V and ground just as the other 7430s using pins 14 and 7 respectively. 2. Wire pin 1 to the "frequency selector" rotary switch position "L", the 12th or extra position. 3. Wire pin 8 (output) to pin 11 of the 7430 that has "1200" at pin 1, "2300" at pin 6, etc. This is one of two 7430s just before the 7402, and has +5 V wired to pin 11 in the original generator. 4. The remaining pins decide what frequency causes an output to occur on pin 8 of your added 7430, and are wired to outputs of the three 74193 "countdowns." Pin 2 is wired to "1024", pin 6 of the third 74193. Pin 3 is wired to "256", pin 3 of the third 74193. Pin 4 is wired to "64", pin 6 of the second 74193. Pin 5 is wired to "16", pin 3 of the second 74193. Pins 6, 11, and 12, the remaining input pins, are wired to the +5 V bus. When the "frequency selector" switch is set to position "L", a 2400 Hz output results. This is the extent of the modifications if all you wish is a 2400 Hz source in addition to the original frequencies.

Generating a "Gray Scale" Satellite Picture

By building an additional adapter, the added 2400 Hz tone may be changed into a gray scale generator signal. This requires only a few more TTL ICs, and is quite inexpensive. For setting up a monitor for accurate presentation of the weather pictures it is hard to top, as it provides a gray scale pattern including the 0% black, 80% white, and 100% sync signals mentioned earlier.

Since the adapter requires an unusual clock signal as well as the very accurate 2400 Hz from the W0LMD unit, a complete countdown chain required for the satellite reception and presen-

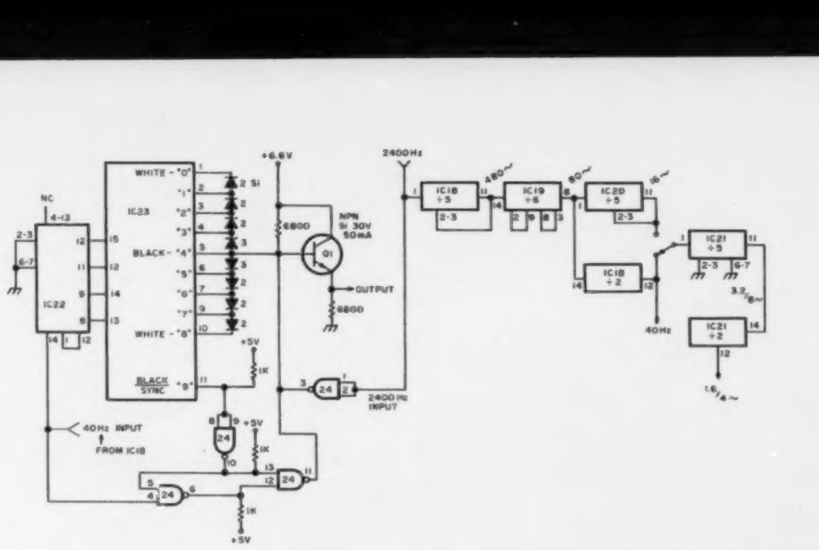


Fig. 1. Q1 emitter: "0" = 0-4.8 V; "1" = 0-3.6 V; "2" = 0-2.4 V; "3" = 0-1.2 V; "4" - 0 V; "5" = 0-1.2 V; "6" = 0-2.4 V; "7" = 0-3.6 V; "8" = 0-4.8 V; "9" = 0 V/0-6.0 V. IC18-22 (7490): pin 5 = +5 V; pin 10 = ground. IC23 (7445): pin 16 = +5 V; pin 8 = ground, IC24 (7403): pin 14 = +5 V; pin 7 = ground.

tation is included as part of the adapter. Build it in its entirety and you have all the timing signals required for your satellite ground station.

The 2400 Hz square wave from the WØLMD unit enters the adapter unit and is sent two ways (see Fig. 1). The first is to the input of the gray scale generator and one pole of a switch that allows straight through operations. The second is to a countdown chain of dividers that ends up providing the basic signals of 1.6 and 4 Hz used for horizontal scanning on each of the satellite's two modes. Included in this slightly different arrangement of dividing is a source of 40 Hz (a 25 ms period). This 40 Hz signal drives the 7490 counter, IC22, which in turn causes IC23, a 7445, decoder's outputs "0" through "9" to go low for a 25 ms period each. If further gating were not used, this would result in an output from Q1 emitter of ten 25 ms long outputs. The 7400, IC24, is added to cut one of these outputs into two 12.5 ms periods. These three ICs are the only ones that really comprise the gray scale generator, and their cost at going rates is approximately: 7490 – .76, 7445 – 1.10, and 7403 – .19, for a total of $2.05. A word may be in order here about the IC numbers since I used IC1 to IC16 for the original WØLMD unit, IC17 for the added 7430 to get 2400 Hz, IC18 to IC21 for the timebase countdown dividers, and then IC22 to IC24 for the gray scale generator. Simple as that.

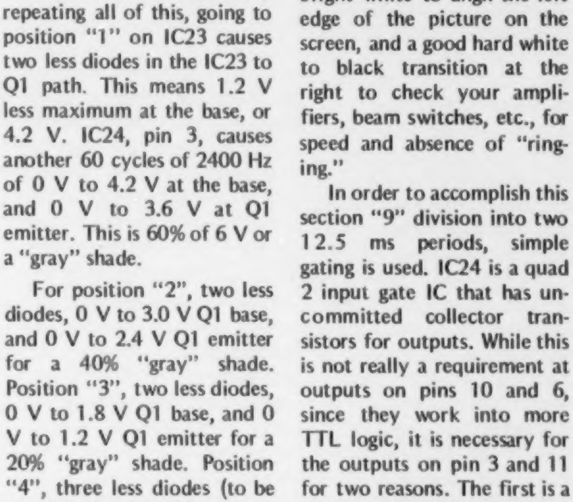
While the diode arrangement around the IC23 outputs may not be unique, I have not seen it elsewhere; I frequently use it to make up various staircase generators. With the added IC24 gate, these diodes cause a 5 level staircase, first descending, then ascending, for the positions "0" to "8" of the 7445 IC23. The staircase is formed as follows: 1. Position "0" going low through nine diodes (junctions) causes a voltage of approximately 9 times .6 V, or 5.4 V, at the base of Q1. For 25 ms (one clock period) this is as *high* as the base of Q1 can go. Meanwhile, at the output of IC24, pin 3, 2400 Hz transitions are occurring throughout IC23's ten clock periods. This creates or allows 60 cycles of 2400 Hz square waves, 0 to 5.4 V P-P, to occur at the base of Q1. Allowing for the one .6 V drop across Q1 from base to emitter, these 2400 Hz square waves become 0 V to 4.8 V P-P. Assume for a moment a 0 V to 6 V maximum output from Q1, and the 0 V to 4.8 V square wave would represent 80% of that figure; thus we will call position "0" the "white" level.

Without completely repeating all of this, going to position "1" on IC23 causes two less diodes in the IC23 to Q1 path. This means 1.2 V less maximum at the base, or 4.2 V. IC24, pin 3, causes another 60 cycles of 2400 Hz of 0 V to 4.2 V at the base, and 0 V to 3.6 V at Q1 emitter. This is 60% of 6 V or a "gray" shade.

For position "2", two less diodes, 0 V to 3.0 V Q1 base, and 0 V to 2.4 V Q1 emitter for a 40% "gray" shade. Position "3", two less diodes, 0 V to 1.8 V Q1 base, and 0 V to 1.2 V Q1 emitter for a 20% "gray" shade. Position "4", three less diodes (to be certain Q1 goes off), 0 V at Q1 base, Q1 off, 0 V and no 2400 Hz at Q1 emitter for a 0% black. Position "5" is the same as "3" by adding diodes back in. Position "6" is the same as "2", "7" the same as "1", and "8" the same as "0".

Position "9" is somewhat different to allow two features. One, it was desired to retain the same 12.5 ms wide sync as is present from the satellite, such that any time dependent circuits in the monitor would not see an artificially long (25 ms) sync signal. Two, since the period had to be divided in half to get the 12.5 ms sections, it was felt that the second half would be used for sync, thus causing it to occur just before the next horizontal line as in the satellite. Further, the first 12.5 ms section is made a 0% or black signal. This means presented on the screen will be 9½ bars going from white to black to white, and a half bar of black. This allows a bright white to align the left edge of the picture on the screen, and a good hard white to black transition at the right to check your amplifiers, beam switches, etc., for speed and absence of "ringing."

In order to accomplish this section "9" division into two 12.5 ms periods, simple gating is used. IC24 is a quad 2 input gate IC that has uncommitted collector transistors for outputs. While this is not really a requirement at outputs on pins 10 and 6, since they work into more TTL logic, it is necessary for the outputs on pin 3 and 11 for two reasons. The first is a TTL rule regarding the direct connection of two TTL device outputs having com-


BREAK PIN 11 CONNECTION TO +5V AND WIRE PIN 11 TO IC17 PIN 8 AS SHOWN
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1500
TOROIDS
88mH
88mH
.022
OUTPUT
"1024"
"256"
"64"
"16"
+5V
17
.082
.15
.082
1K
10K
K4EEU FILTER
ORIGINAL TONE GENERATOR CIRCUIT
"SSTV"
IC17 ADDER
TO ADAPTER
POSITION 12 ON ORIGINAL ROTARY SWITCH MARK "2400Hz"

Fig. 2.

mitted outputs – a no-no! Secondly, and more importantly in this case, we want the base of Q1 to go all the way up to 6.6 V when not being acted on by IC23, or IC24 outputs pins 3 or 11.

Following the gating of IC24, the 40 Hz clock rate enters all the time on pin 4. This would cause 12.5 ms high and 12.5 ms low outputs at pin 6 if pin 5 were high, and a steady high at pin 6 when pin 5 is low. Pin 5 is tied to pin 10 of IC24. Pin 10 also ties to pin 13. By putting pins 8 and 9 together, the 8-9-10 gate is used as an inverter. The inputs 8-9 are wired to position "9" of IC23, and thus are high except when IC23 is in position "9". The low that occurs at pin 10 disables both the 4-5-6 and 11-12-13 gates of IC24 by holding at least one input low and, therefore, their outputs at a fixed high.

When position "9" is reached, it is the fall from high to low of the 40 Hz clock signal that causes this, and thus the low portion of the 40 Hz is on pin 4 of IC24. A low from position "9", inverted through the 8-9-10 gate to a high at pin 13 half enables the 11-12-13 gate. A low at pin 4 keeps pin 6 high and also pin 12 high, causing a low at pin 11. This low turns off Q1, and a 0% black is present for 12.5 ms. When the high part of the 40 Hz clock comes along and makes pin 4 high, then pins 6 and 12 go low and pin 11 now goes high. Since the base of Q1 is not held down during this 12.5 ms period by either gate 11-12-13 or IC23, only gate 1-2-3 affects it. As such, 30 cycles of 2400 Hz square waves at 0 V to 6.6 V P-P appear at Q1 base. This is then 0 V to 6.0 V at Q1 emitter, or 100%, namely "sync"!

You should see by now it takes longer to explain the adapter than to build it and get it running combined. Also, it may have occurred to you that any accurate 2400 Hz into the adapter will accomplish the same result. Quite true! I happened to build the W0LMD unit first; I have been having a ball finding out the many uses for it, so I used it here. It is great – and accurate – and it just was not worth the trouble of building another 2400 Hz source whose accuracy I could not trust as much (non-crystal source, etc.).

An SASE will get all the help I can give on the gray scale generator or the new timebase, but questions on the monitor or the articles contained in the references should go to the respective authors, since in those portions of my ground station I only copied their work and mine worked fine the first time. This way they are more apt to be familiar with any problems you are having than I would be. The generator I will take full responsibility for and will try to get you a rapid reply. ■

References

[1] *73 Magazine*, WB8DQT, August 73, p. 45. *73 Magazine*, WB8DQT, Sept. 74, p. 79. *73 Magazine*, WB8DQT, Dec. 74, p. 48. *73 Magazine*, WB8DQT, June 75, p. 128. *73 Magazine*, WA9MFF, June 75, p. 22. *73 Magazine*, WB8DQT, July 75, p. 76. *73 Magazine*, WB8DQT, August 75, p. 45. *73 Magazine* WB8DQT, Oct. 75, p. 60.

Note: While giving the unit adapter its final checks and preparing this article, some additions crept in, and are noted in Fig. 2. The output here is a square wave, as in my previous RTTY and SSTV adapters, and should be run through a like filter. The K4EEU filter used there works just fine and can be used here, so I include it in Fig. 2. Bert's filter appeared in Ham Radio, *July 1973, p. 6, for those who care to see its original use.*

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It is common knowledge that heating bills can be reduced by setting the heat lower at night. As a matter of fact, most heating engineers will tell you that a savings of up to 16% can be realized by lowering the nighttime temperature in a home by 10 degrees Fahrenheit for at least 8 hours every day during the winter heating season. While it is very easy to use your index finger to push the thermostat back 10 degrees every night, this manual method does not turn out to be very reliable. Either someone forgets or the attitude of "I'm not getting up in the cold to turn up the heat" seems to prevail. Thus, the use of an automatic "day/night" type of thermostat is a better way to cut down on heat bills. This type of thermostat, however, is usually rather expensive ($50-75) and must be used in place of each thermostat in the house. In a dwelling with multiple zones and multiple thermostats, this can be quite expensive.

This article describes a "day/night" heating control which will automatically turn the heat down at night and back up again in the morning. While this device sounds like a "day/night" thermostat, it is different in that it connects to the 24 V ac electrical system of the furnace and will control all of the thermostats in a typical house. It is easy and economical to build and can be installed quite simply on either a hot water or hot air heating system. It has been designed so that an inexperienced experimenter can build, install, and maintain it.

Principles of Operation

A typical heating system has a circuit diagram similar to the diagrams in Figs. 2 and 3. Note that, in these diagrams, all thermostats have one side connected to a common point or common wire. The entire heating system (except for the control for hot water reservoir) is disabled if the connection between the 24 V ac transformer and this common point is broken. The "day/night" heating control has a 117 V ac relay connected to a cyclic timer. The "normally on" contacts of this relay are used to provide the connection between the transformer and the common point. At night, when it is time to set the heat back, the timer turns on the 117 V ac relay breaking the connection between the thermostats and the transformer disabling the heating system.

When I was building my first unit, I asked a neighbor who was a heating engineer if there was any reason why I should not let the house get as cold as possible during the night. His answer was a definite, "Yes, there's a very good reason." It turns out that a very complex relationship exists between the outside temperature, the day/night setback temperature differential, and the amount of fuel needed to bring the house up to temperature the next day. Because of this relationship, there is an optimum "setback" temperature, which for the average house is about 10 degrees for a maximum savings of 16%. If you exceed this setback temperature by very much, your savings will decline and it is possible to reach the point where you are ultimately using extra fuel rather than saving fuel. For this reason, an additional thermostat was included in the system to provide an overall nighttime temperature for the house. This additional thermostat uses the 24 V ac transformer on the furnace for power and is connected to a 24 V ac relay. This thermostat is set at a temperature which is 10 degrees less than the daytime temperature. When the house temperature falls below this nighttime setting, the thermostat closes, turning the 24 V ac relay on. Since the power leads for the 117 V ac relay go through the normally closed contacts of the 24 V ac relay, the 117 V ac relay will be inactivated and the system will go back to normal. At this point, all of the daytime thermostats take control and call for heat as required. When the temperature rises above the nighttime temperature, the heating system is once again disabled. Note that the nightime thermostat does not turn on all zones automatically but merely puts the heating system back to daytime or normal. This was done to

This project is a perfect opportunity to use your skills to make a few dollars on the side. This easily built thermostat can be sold to friends and neighbors and installed by you. – Ed.

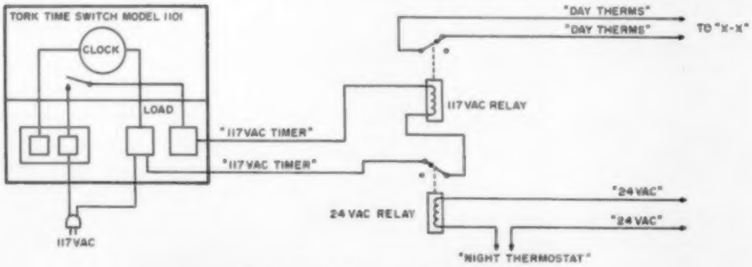


Fig. 1. Day/night furnace control.

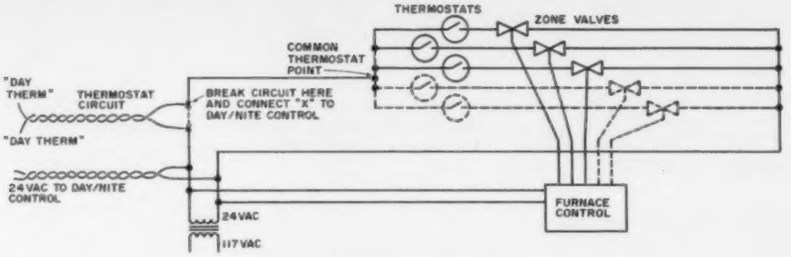


Fig. 2. Typical hot water heating system.

allow a given maximum temperature in a particular zone and to permit a zone to be turned off. If a zone is turned off during the day, it will not be activated at night by this system. I wanted this feature for my own house where the basement zone is off except for rare occasions. If I had used the nighttime thermostat to turn on all zones, I would be wasting heat in the basement.

Construction

Simple, quick construction was one of the design goals of the system since many neighbors expressed interest in this device and contemplated building it for their homes. Reliability was another goal, since few of the neighbors had an electronics background and thus could not troubleshoot the system should a malfunction occur. Consequently, parts were chosen on the basis of ease of construction and reliability, rather than on a minimum cost basis. Those readers with a good junk box and electronics knowledge can improvise and substitute, possibly saving a few dollars here and there.

I might mention that an all solid state version of this unit was built and tested; however, since it was not totally reliable and was expensive to build, it was abandoned. It is difficult to beat the relay in regard to reliability and cost.

A small metal box with dimensions of 3" x 4" x 5" or larger is used to hold the two relays. Top mounting sockets are used for the relays so that it will not be necessary to punch large holes in the box. A small quarter inch electric drill and a screwdriver are the only tools needed for the project. After assembling the unit, both the timer and the control unit are mounted on a wooden board which can be nailed to the cellar wall or any other convenient place. I originally mounted lights on the box, but since they have no real value and add unnecessarily to the cost of the unit, they were omitted in all subsequent units. Hence the circuit has no lights shown.

All connections made inside the box are brought out through a ½" grommet in a ½" hole. Connections should be labeled as shown in Fig. 1, using masking or adhesive tape.

The timer used is a heavy duty industrial timer and is very inexpensive for its quality. If you wish to cut corners, you may substitute the Sears #34H6442, which sells for about $7.00 in their catalogue.

Installation

Install the nighttime thermostat in a central part of the house. Do not mount the thermostat on an outside wall or a wall that gets cold. Use twisted pair, solid thermostat wire or equivalent for the run from the thermostat to the control.

After the control box and timer are mounted on the board, connect the timer and control together as shown. (If you use a timer other than the Tork timer, then connect the 117 V ac timer leads to the terminals marked "load" on the timer.) Plug the timer into an outlet and test the unit as follows: Throw the lever in the timer to "on" and the 117 V ac relay should pull in. Throw the lever to "off" and the relay should drop out. Unplug the timer, cut the wire going from the "common thermostat point" to the transformer, and connect the two ends to the control box leads marked "day therms." Turn on one of the thermostats in your house and the heat should go on. Leave the thermostat on, plug the timer in and turn the lever to "on." The heat should go off. Connect the leads marked "24 V ac" to the 24 V ac transformer and connect the "night therm" leads to your night thermostat. Turn the timer on so that the 117 V ac relay turns on. Turn the nighttime thermostat to ten degrees or so below the actual house temperature. The heat should stay off. Click the night thermostat on. The relays should click and the heat will go on. At this point the system is installed and ready for operation.

Note that all connections should be made with the appropriate circuits de-energized. Never work on a "live" circuit. When making connections to the 24 V ac transformer, be sure that the circuit to the furnace is turned off. In some cases, it may take two to three minutes for the heat to come on due to inherent delays in the controls for the furnace and the zone valves.

Operation and Use

In our household, the timer is set so that the heat is turned off ½ hour before bedtime and turned on ½ hour before rising. With these settings, our house remains comfortable before going to bed and warms up before rising. In cases where we will be staying up late beyond normal bedtime, we merely turn the nighttime thermostat way up until it "clicks in." This puts the system back to normal without having to change the timer. In this case we turn the thermostat down before retiring and the nighttime system takes control.

It should be noted that when you set the trippers on your timer, the trippers are set to turn "the control on" and "the control off." This corresponds to disabling the thermostats and enabling the thermostats. In cases where no one is at home because of school or work, additional trippers may be added to turn the control on at 8:30 am and off at 4 pm or any other time. By doing this, the heating system would be in "nighttime" mode from 8:30 to 4. In this example, an additional fuel savings would occur for 7½ daytime hours.

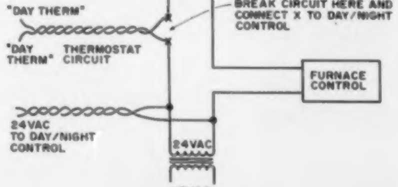

THERMOSTAT
"DAY THERM"
BREAK CIRCUIT HERE AND CONNECT X TO DAY/NIGHT CONTROL
"DAY THERM"
THERMOSTAT CIRCUIT
FURNACE CONTROL
24VAC TO DAY/NIGHT CONTROL
24VAC
117VAC

Fig. 3. Typical hot air heating system.

Recommended Parts List

Quantity	Description	Supplier	Approx. Cost
1	120 V ac relay Line Electric Co. Model MKH2A	Hatry's	$6.50
	or		
	HI-G, 115 V ac Model 4SLRP-215	See notes	See notes
1	24 V ac relay Line Electric Co. Model MKH1A	Hatry	
	or		
	HI-G, 26.5 V ac Model 4SLRP-126	See notes	See notes
	Sockets for Line Electric Co. relays – Potter and Brumfield #27E122	Hatry	6.00 (3.00 ea.).
	or		
	HI-G #4SLRP	See notes	See notes
1	Tork Time Switch Model 1101	Graybar	14.00
	or		
	Sears #34H5870	Sears	14.00
	or		
	Sears #34H6442	Sears	7.00
1	Thermostat Sears #42H9235	Sears	14.00
	Thermostat wire as required Sears #42H9151	Sears	1.35/35' roll

Notes to Parts List

Prices given may fluctuate, and do not include shipping and taxes.

The HI-G relays shown as alternates are very high quality hermetically sealed relays. They are recommended if you have means for cutting the two required 1-3/32" holes and don't mind doing a bit of metal work to get them mounted. Write to the manufacturer to get the address of the nearest distributor and the current price.

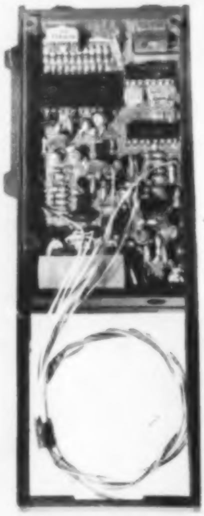
The Line Electric Co. relays are not hermetically sealed but do have a dust cover.

Distributor addresses: Hatry Electronics, 500 Ledyard St., Hartford CT 06114; Graybar Electric Co., Inc., 231 Newfield Ave., Hartford CT 06105; HI-G Incorporated, Spring St. and Route 75, Windsor Locks CT 06095.

Additional trippers cannot be added to the inexpensive timer noted in the parts list.

This system has been working for several years now and has saved us a real 10% in fuel utilization. We are quite pleased with the system; however, I will admit that it did take a while to get used to it. First of all, the bedroom does get cold at night, which means that we had to learn to sleep with three blankets and a quilt. Second, visiting the "head" in the middle of the night can be a chilling experience. Third, the temperature throughout the house at night is not as uniform as when the system is in normal. This is of little consequence since you should be asleep at this time.

Very obviously, the advantage of this system is fuel savings for the individual homeowner. It would not be unreasonable to save twice the cost of the unit during the first winter. From the savings that our family is seeing right now, we may do considerably better. Aside from the savings experienced in the individual household, this unit could have an impact on nationwide fuel economy if it were used on a national basis. It could help us conserve our scarce national fuel resources. ■



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Mod for the Heath IO-102 Scope

- - faster warm-up

Walter W. Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

The Heath IO-102 scope kit appears to be one of the "better buys for the money." The 30 mV vertical sensitivity, 80 nanosecond rise time, and 5 MHz frequency response seem to fill the bill. Actually, the vertical response is adequate for viewing 15 MHz or higher signals with sufficient trace height to be usable. Assembly is on four main circuit boards: vertical, horizontal, sweep, and power supply. The finished unit is uncluttered, internal adjustments are no problem, and most components are easily serviced.

Critical power supply voltages are zener regulated, a fact which contributes to the operational stability after warm-up. The power transformer, which is double shielded, and circuit board layout result in a trace like those drawn in textbooks.

The initial alignment and internal adjustments, although not difficult, *must* be performed as directed. An accurate VOM or VTVM is the only equipment needed. During this alignment, one wishes he had a screwdriver with a ten to one drive. However, with a light touch, the desired results can be achieved.

Heath states that vertical drift during warm-up "for the first half hour or so" is to be expected. Experience with two of these units was as follows: From a cold start at 70° F, the trace was completely off the screen for the first ten minutes. After ten minutes, the trace appeared at the top of the CRT and drifted downward for 35 minutes, at which time it stabilized and no further drift was noted over several hours of operation. For someone who turns on the instrument and intends to use it all day, this may not appear as a problem. My use is on an intermittent basis and I found juggling the vertical position control inconvenient. The addition of four simple heat sinks produced two improvements:

1) A usable trace on the screen in 3 to 4 minutes.
2) A completely stable trace, without touching the position control, in 12 to 15 minutes.

Two heat sinks (Fig. 1) were made from 1/8 in. aluminum and attached to the vertical output transistor heat sink tabs as shown. The tops of these sinks, which were bent 90°, may be secured to the CRT shelf with standoff insulators or RTV cement. Two additional heat sinks, 1 in. by 1 in., were attached to the driver transistors with a small wrap-around wire.

Heath incorporates a 1 volt peak to peak calibrating signal at a front panel jack. I personally prefer a square wave calibrating signal and incorporated the circuit shown in Fig. 2. This calibrator provides a clipped sine wave signal of .1 V, 1 V, and 10 V. Three pin jacks were added next to the vertical input ground jack, to bring these signals to the front panel from the circuit which was mounted on the cover of the power supply transformer using existing screws.

All things considered, I feel you will find this instrument a worthwhile addition to your test bench and a pleasure to use. ■

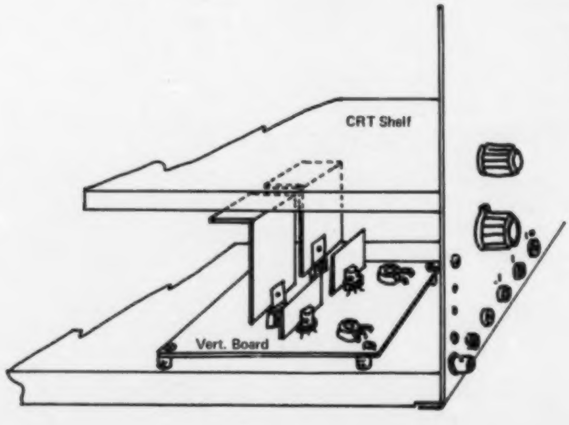

Fig. 1.

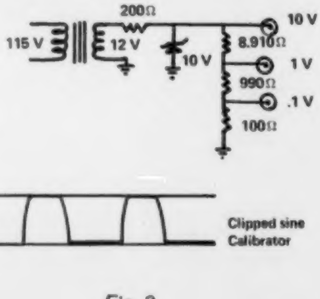

Fig. 2.

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JUNE 63. Surplus Issue: DMQ-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band-spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, $5 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VE8 hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus Issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter uses, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state troubleshooting, IC freq counter (many errors & omissions), "ev" transformers, space comm odyssey, pulsar info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gene, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW summy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M ssb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio-controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic variac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, bandswitching Swan 250 & TV-2, 88mh selectivity, match exercizes, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part 11), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SSQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, removating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm dope & repeater guide, meggering your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx aligner, 5/8 wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage stamp 6M tx, extra class study (part 16), Bishop IFNL, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, environment & coax loss, 2-el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid-state vhf exciter, delta-fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 5), "transi-test" (no good – errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, varactor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise blanker, repeater problems, Motorola HT mods, microwave repeater linking, digital ID unit, tuneable 2M fm rx/tx, repeater directory, fm marketplace, meter evaluator, varactor modulator, simple sig gen, touchtone hookup, hf preselector, 10M 12W tx.

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple af filter, 1-tube 2M transceiver, surplus 2M power amp, general class study (part 8)

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat-sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gnd-plane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi-power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log-periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 80/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant acoupler, Motorola HT info, SSTV-ISB, Class B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp compressor, single-IC rx, "432-er" final assembly, transistor keying circuit, 7-segment readout with nixie driver.

APR 74. Vox for repeaters, tone-operated relay, hf transverter, 10-to-2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), ex warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

Since there's little to get stale in back issues of 73 (our magazine is not padded ... like others ... with reams of activity reports), you'll have a fantastic time reading them. Most of the articles are still exciting to read ... and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted ... and more. You'll really get a kick out of the back issues.

photo-flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi-power lo-pass filter, 6M preamp, 3-wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar 7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16 wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

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David L. Dobbs K8NQN
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The UFO Connection

- - that was somebody fooling around, wasn't it?

September 6, 1976

Mr. Wallace Andrews
Director
National UFO Network Inc.
301 Newtown Road
Sagum TX 78155

Dear Wally,

Fantastic! Incredible! Even words like these can't begin to convey the emotional impact of such an experience. Reading over my own formal report, which is attached, I can hardly believe it myself.

After listening once more to tapes of the hypno-analysis sessions, I think it's desirable to supplement my objective report with this narrative account. Please keep it strictly confidential for the time being. It should help to fill in any gaps, and assuaging your curiosity may get you off my back for a while.

As you know from the land line, it all began about 0020 on the 12th of last month. I had to work late at the salt mine. Delay in getting the analytical results which had to accompany a special shipment of gadolinium ingot required my dropping it off at the airport to make the morning flight before heading home. As usual, I was monitoring 16/76. Bryce WD9AUK was trying to give directions to a mobile who was lost downtown. I figured the repeater would be clear for an autopatch to the XYL by the time I got up out of the hole by the cemetery. And that's when weird things began to happen.

As Bryce was signing, his voice suddenly cut off in mid-sentence without any beep from the repeater. Then the engine began to miss and the headlights flickered and got dim. Almost before I thought "short circuit," everything seemed normal again except that the receiver stayed squelched or dead. At that point the top of the hill was in sight and it was now or never for the phone call. Hoping the rig was OK, I identified for autopatch and punched the access code. They tell me that no one monitoring heard a thing, but instead of the dial tone there was this indescribable voice!

"Priority break," it intoned, followed by some strange call mobile 8. Usually I remember calls, but the odd quality of that voice must have distracted me. It was kind of melodious, deep and compelling, with an accent I couldn't place. I just said, "Go break," and kept listening. From that point on, the whole incident had sort of a dreamlike quality.

That fascinating voice went on to say his vehicle was disabled over on old route 84 near the quarry and requested some assistance. It was my impression, Wally, that he was probably some foreign ham operating on a reciprocal license. The nationality escaped me, but as a Technician I don't work the low bands, and there are a lot of new countries these days. Since my QTH was only a few miles from him, I told him to stand by and I would be there as soon as possible.

It's strange, but the logical thoughts you'd expect under the circumstances just never entered my mind. The lack of traffic on the highway was unusual for that time of night. I don't think another car was in sight. And old 84 is supposed to be blocked off now that they are starting work on the interstate link. But none of those things occurred to me. All I could think of was to get there and see how I could help. Even the air freight shipment in the trunk and calling home seemed trivial, like something in another dimension.

There was no sign of a roadblock at the intersection with old 84, so I hung a sharp louie. The decrepit pavement made it impossible to drive faster than 15 or 20. That was fortunate, because as I swung around a blind curve about a half mile from the quarry, there was a large branch blocking most of the road. It was when I got out to drag it out of the way that I noticed the light.

To the west, you remember, the land drops off into a valley. Down there in a clearing, about 200 yards away, the treetops were illuminated — flickering, as though a fire might be burning, but not that color. More bluish, like a policeman's beacon rotating. And then suddenly I saw him!

"Him" seems to fit somehow, but don't ask me why. He had come up to the car while my back was turned and was standing near the open door. In the glare of the headlights it was hard to see well, but he was short — probably not five feet in height. He had on a silvery, one-piece outfit that looked like aluminized coveralls or a wet suit. Moving out of the headlight beams and towards the car, I was about to say, "Hi," when my first good look stopped me dead. He didn't have a recognizable face!

It could have been a mask made of the same silvery material with large, round holes for eyes and a slit for a mouth. Or maybe that was his face! I don't know. But at that point all of our past conversations came home to roost and the realization of what might be happening swept over me like a tornado. Despite all the knowledge, all the wishing, my spine went down to absolute zero. Fear froze my guts. I began to shake like a gun-shy dog.

What happened next was really something. While we were standing there looking at each other, there was a tremendous flow of information into my mind at a fantastic rate. It was like a data link between two computers. Ideas weren't expressed in words at all – there was just a stream of impressions. The concepts I'm about to convey were all received in the space of 10 or 15 seconds. They didn't seem to emanate from the humanoid or even through him.

"Do not fear. To the extent that you identify with the reactions of your body, we are unable to communicate without suppression of your consciousness. Since your cooperation has been voluntary, we would avoid this. Keep your awareness *here*." At this point the humanoid raised his arm slightly, and I felt a warm sensation centered inside and near the top of my head. An intense interest in what was occurring replaced the fear and I felt OK.

Somehow I knew, or was told, that my visitor was a biological robot (what you call a cyborg) for a civilization which had evolved beyond the material plane. My unasked question, "Where?" was answered with the impression of several rather inconspicuous stars in this galaxy visible only in the southern hemisphere. I understood that a critical component of the space warp drive on a scout ship needed replacement, and it would be necessary to "borrow" the material I was taking to the airport for a short time. "Borrow" wasn't quite the concept, but my concern was answered with the assurance that it wouldn't be harmed in any detectable way. Apparently it was to be used as a pattern or catalyst.

When it was apparent that the communication had ended, the humanoid moved to the rear of the car and waited. Rather slowly, I walked up to the open door and reached inside for the keys. That buzzer sounded like about 90 dB until I closed the door. Getting the trunk open with that guy about ten feet behind me was kind of creepy, but finally the lid swung up.

The same nonverbal communication told me that the humanoid (that's not the term – it was more like servant/instrument/creation) would carry the package and I would be permitted to follow him. I just stood back while he ripped off that shipment (worth more than I make in a year) and took off through the woods with it. The weight didn't bother him at all. It was almost as if he floated along.

Getting through the brush in the dark was slow going and he got way ahead of me. My flashlight wasn't doing a bit of good. But I kept heading toward the light and reached the clearing just in time to see him disappear up a ladder, which immediately retracted into the side of the ship. When I got to within 300 feet or so, I felt the hair on my arms and what's left on my head begin to stir and something told me to stop. There must have been a whopping electrostatic charge on that saucer.

The craft looked just like the photos we have seen a hundred times. It was about 40 feet in diameter, supported on three legs, with light pouring out from underneath it. Up near the top of the bell were what appeared to be several round ports, but I couldn't see anything through them but light. It was eerie standing there and listening to the low, humming noise that emanated from the ship, and I started shaking again until the directions I'd been given were recalled. In perhaps ten minutes or so the ladder popped out again and silversuit reappeared, carrying my package. I was mentally kicking myself for not having moved around to where I might have been able to see into the ship, but something told me it wouldn't have been wise. There was an impression that we had to learn in our own way – that we were being evaluated, and that greed was our biggest problem. This made me feel kind of bad, and then there was the thought that our day would come – that pretty soon we too would travel the universe.

By then the package had been placed on the ground about 20 feet in front of me and the humanoid had withdrawn back toward the ship. As he stood there, it seemed like he should wave or say, "Thanks." But the thought that came was, "It is imperative that you return quickly to your vehicle. To watch our imminent departure from less distance would be injurious to your health!"

Needless to say, I picked up the package and made tracks in short order. Looking back for a second as I reached the edge of the clearing gave me a view of silversuit gliding up the ladder, which promptly retracted. Plowing through the brush with the package, I was about halfway back to the car when the humming noise started rising in pitch and the light got brighter. By the time the car lights came into view, the ship was hovering at treetop height over the clearing, swaying slightly. Almost instantly it accelerated to tremendous velocity toward the north. In about a second or two the light winked out and only stars were there.

Believe it or not, the package didn't seem to have been opened when I examined it in the car. Still not thinking very clearly, I drove on to the airport, not really listening to the late night chatter on the repeater. From there it was a beeline over to Leo Springfield's house, where I got him out of bed and we spent the rest of the night working up that preliminary report. You know the rest, except that we got a call from Sandia today wanting to know what the hell we had done to the gadolinium. Seems the magnetic properties were slightly odd and when they analyzed it they found a depletion of the lightest isotope. Of course, we have no official explanation for it.

This last point I hesitate to mention, because it can't be proven. But when I left the plant that night, the latest issue of *73* was rolled up in my right pants pocket. There hadn't been time to look at it at work. It was still there, bumping my wrist in the clearing. But it wasn't there afterward – not in the car, at Springfield's, or at home. I think it fell out when I stooped to pick up the package, but we couldn't find it anywhere the next day, when the area was photographed. It might have ended up in a museum on Epsilon eridani II or somewhere, and I hadn't even read it! But three days later, there on the table in front of my rig, were TWO copies! They hadn't been there that morning because the XYL dusted in there.

That, and one other thing make me sure they have a sense of humor. My subconscious couldn't have made up anything as corny as this. When it was consciously recalled I laughed too hard to be scared any more. You'll find it about halfway through the first hypno cassette, where Dr. Seaman says, "You are now listening to the breaker on the radio. Tell me what you hear." And then there's my voice, trying to imitate that odd accent. "Priority break. This is HI1UFO mobile 8."

Boy, do I wish he would QSL, even if he was a bootlegger!

73 for now,
Dave

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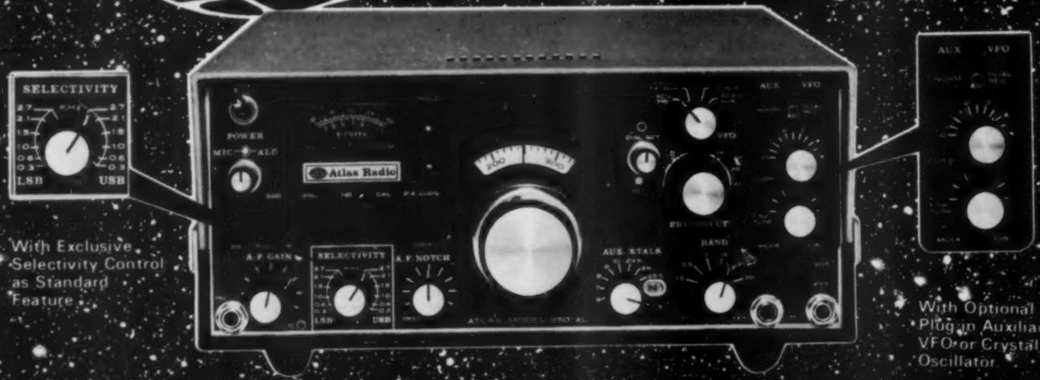
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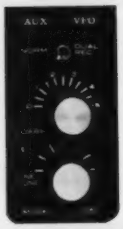

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I/O EDITORIAL

THE ALTAIR BUS

For some reason there has been a move recently to rename the Altair bus the S-100 bus. Dirty pool.

First, what is a bus? Well, we don't use bus structure much in amateur radio since we have very few common connections between the various modules of radio equipment, but the bus system has evolved for computers. A bus is a set of parallel wires to which the various modules of a system are connected. Most computers use a mother board with rows of connectors on it into which plug the boards which make up the system. All of the terminals on the connectors are connected to the same terminals on every other connector.

In the Altair, a 100 terminal connector is used, with 50 terminals on each side of the PC board. This set of wires carries power to each board, feeds in the signals and takes them out. To save on pin connections, many of the microprocessors use the same wires for feeding data into the chip as out, and this means it is possible to get by with fewer wires in the bus. Some of the bus wires carry handshake signals, etc.

While some hardware people rail out against the Altair bus, making much hay over this difficulty or that, it has become the de facto standard of the microcomputer world . . . partly because it was first . . . partly because its originator, MITS, sold more Altairs than everything else combined . . . and partly because, for all its faults, it is a very efficient and useful bus system . . . and it works.

The Altair bus is used by the Imsai and Polymorphic computers, plus a host of boards for ordinary and specialized functions. A recent estimate put the number of boards so far available for the Altair bus at 100. An even more recent (last week) count placed the number at over 150! I'm sure hoping for a series of articles describing all of the Altair bus compatible boards for publication in *Kilobaud* . . . writers please take note.

My reaction to the move to rename the bus the S-100 is that credit should be given where credit is due and it should be called the Altair bus.

ATLANTA JUNE 18-19

Pencil those dates in and make your reservations for one of the biggest and the best hamfest/computerfests in the country. Dayton is big, for sure, but other than the hamfest, what have you got? Atlanta is worth planning a couple days or so of vaction to correspond with the hamfest, for there are all sorts of fantastic things to do around there.

The 1977 Atlanta Hamfestival will be held at the Atlanta Marriott Hotel in downtown Atlanta . . . there are 1000 rooms available, more than twice what was available last year . . . and the rates will be $18 single and $24 double . . . free parking . . . big flea market area which is inside and air conditioned. Call 800-228-9290 toll free to make your hotel reservations . . . and better not wait too long.

There will be 120 exhibits, fantastic prizes, some of the top speakers in hamdom and computerdom (particularly featuring Ed Roberts, the president of MITS), and probably the best hamfest food you've ever tasted. Get a group together from your club and have a great time. How about a convoy with 2m intercom along the way?

The hamfest will be emphasized on Saturday and the computerfest emphasized on Sunday. This will be your chance to see the very latest in ham gear and meet the manufacturers and major dealers (Tufts Radio will be there again this year) . . . and to see what computers look like in the flesh, with a lot of computer exhibits. If you've been putting off messing with microcomputers, you'll be interested to see 'em in action . . . and get your hands on them to play some games . . . see 'em work RTTY . . . plot OSCAR passes, etc.

Last year I took a little time to see Underground Atlanta, ogle the incredible downtown hotels, and visit nearby Stone Mountain . . . a sort of entertainment and picnic center. There's a lot to see in the area . . . and do . . . and the restaurants . . . wow!

KILOBAUD

A high capacity data channel — *Kilobaud* — and the name of our new magazine, the first issue of which is now out. We were going to call it *Kilobyte*, but decided to duck a lot of legal expenses by changing the name slightly . . . rather spend the money on a better magazine than lawsuits.

The first issue runs 144 pages and is pretty good. It'll be better as we go — we're trying out some new ideas and after a while we'll settle down. Subscriptions are $15 a year — we'll start with the first issue while it lasts.

The hobby computer field is moving rapidly — new microcomputer chips are coming out faster than they can be put into systems. The most important newer chip is the Z-80, which is an advanced 8080A chip and may, despite my reservations about it, soon be the most used hobby computer system microprocessor.

The proliferation of TV games has opened many eyes. It started with one guy in his basement turning out Pong games and now it is sweeping the country, with many big manufacturers in there making hay. Not that Atari, the originator, is doing badly. The next step is one that you could make, if you wanted to. If you visit any of the arcades you'll see that the most popular games, by far, are games using a television screen and some simple controls . . . Tank . . . Red Baron . . . Quick Draw. These all use a Fairchild F8 microprocessor chip and the whole thing is done with a program . . . software! You see where I'm heading?

You have to have your own microcomputer going and build an inexpensive graphics generator . . . then write your own action games for it. When you're done, put the whole works onto one board and package it with the controls so it will play through a color TV set . . . and you'll have the world by the tail. If the public will buy ping pong, they'll go crazy over even better action games. Who's going to do it?

PUBLISHER'S DATA PROCESSING

We've been having a ball getting our own computer system going to handle the subscriptions and other jobs around *73*. We already have six CRT terminals going, trying to keep up with the new subscriptions to *73* and *Kilobaud*, and nine more on order for other data handling such as advertising records, bulk copy order records, inventory, repeater lists, club lists, dealer lists, accounts receivable and payable, billing for subscriptions, an article index, things like that.

Once we have all of the programs running smoothly, we'll be able to sell complete systems completely programmed for running a publishing house. The whole works will cost about as much to own as two office employees and will do the work of about ten or so. It should be popular. It should be about ready for a demo in the first quarter of 1977. If you know any publishers, give us a mention.

GROWTH AT 73

One of the reasons for those recent ads for more help at *73* was to keep up with our growth. You may have noticed that the last three issues have been over 200 pages — this takes a lot of work. In recent weeks we've increased the staff by 50%, doubled our typesetting facility, built a second photo darkroom, put in data processing stations on all four floors, doubled our computer capacity, and gone to two shifts in several departments.

We expect *73* to continue running over 200 pages (we're aiming at 500 pages per month), *Kilobaud* should increase from its present 144 pages to over 200 pages shortly, plus three or four good-sized books per month, a couple dozen newsletters, who knows what in computer program sales through the computer stores, and who knows how many complete computer systems for small publishers — it's quite a project for us to produce all this from our 200-year-old house in New Hampshire . . . but it's fun.

WHAT ARTICLES ARE NEEDED

If you are one of the pioneers of hamming or microcomputing, there are several reasons why you should stop every now and then and document your progress. First of all, there are a lot of fellows who would like to not have to reinvent the wheel. Give the other builders a break and let them know what you've done. Then there is the fact that being published makes you an "expert." You get a little less disrespect from fellow hobbyists. Probably of no interest to you is the payment for your article (we pay the highest, by far, in our fields).

The readers are most eager for any IC projects, digital articles, just about anything to do with computers . . . particularly as applied to amateur radio. Teachers in touch with Novice classes may have some good material to interest newcomers, activities of clubs might be helpful to other clubs, etc. Just about anything in small transmitters or receivers is of interest . . . some of these new ICs make fascinating projects possible.

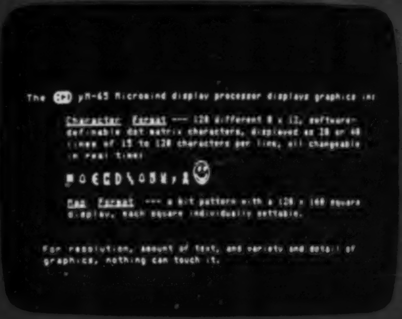
Perhaps you're more into a book. If you have a book in mind, write up an outline plus a couple sample chapters and get in touch. Any one of a hundred outfits can print a book for you, but you need a publisher with distribution channels set up to sell your book . . . you don't make a lot on a book unless it sells well. There is a big need for well-written books on the fundamentals of all aspects of computers . . . and virtually nothing yet available. The day of self-teaching in this field has just arrived.

HAMFESTS AND COMPUTERFESTS

The two combo hamfest/computerfests that have been run so far have been successful enough to indicate that this is a good way to go. The two hobbies are remarkably parallel, with at least a 25% overlap both ways.

Computer exhibits at hamfests and

Continued on page 88



The ECD μM-65 Micromind display processor displays graphics in:

Character Format --- 128 different 8 x 12, software-definable dot matrix characters, displayed as 16 or 48 lines of 15 to 128 characters per line, all changeable in real time!

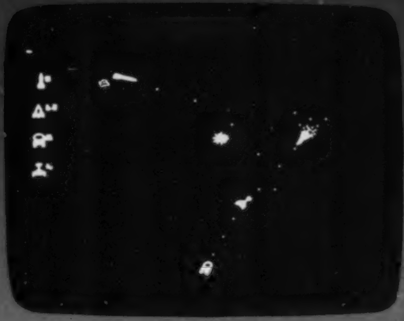
Map Format --- a bit pattern with a 128 x 160 square display, each square individually settable.

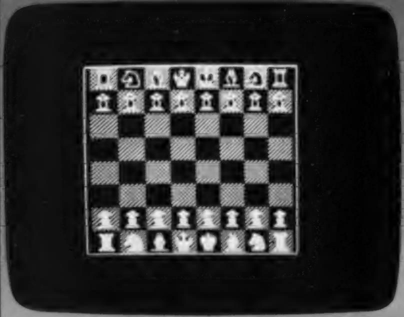
For resolution, amount of text, and variety and detail of graphics, nothing can touch it.

Key Into Maxi-Power @ Micro-Price

Micromind is an incredibly flexible, complete and expandable, hardware/software, general purpose computer system. You won't outgrow it.

Hardware includes an 80 key, software-definable keyboard, I/O interface board, 6500A-series microprocessor (powerful enough for advanced computing), a high-detail graphics and character display processor, power supply, rf modulator, and connections for up to 4 tape recorders plus TV or monitor. An interconnect bus permits 15 additional microprocessors, parallel processing and vastly increased computing power.

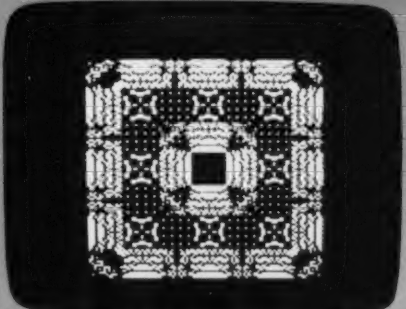




System software—including ECD's own notsoBASIC high level language, on advanced error-correcting tape cassettes—provides a word processing editor, a powerful assembler, a debugger, a file system, graphic routines, and peripheral handlers. We also include dynamic graphic games: Animated Spacewar and Life.

ECD's standard Micromind μM-65 supplies 8K bytes of memory. Additional 32K byte expansion boards and a mapping option give Micromind expandable access to 64 Megabytes. Utilizing software-controlled I/O channels, Micromind's advanced encoding techniques load data from ordinary tape recorders at 3200 bits per second.

Micromind comes to you ready-to-use, factory assembled and fully tested. Among microcomputers, it has the largest memory capacity and the fastest storage. You're looking at the work of the finest display processor on the market. You won't find a microcomputer with a more powerful CPU. You won't find a computer with a more flexible keyboard. You won't find anything to touch it at **$987.54.**



So, quit the kluge scene and key into Micromind. You'll be a main frame performer, with all the comforts of home. We're not fooling...this is the cat's μ!

ECD CORP.
196 Broadway, Cambridge, Mass. 02139
(617) 661-4400

Name ____________________
Address ____________________
City/State ____________________ Zip ________
☐ Fantastic! Check enclosed: $987.54. Shipping paid by ECD
☐ BankAmericard ☐ Master Charge Mass. Resident add 5% Sales Tax
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Signature ____________________
☐ Send me your brochure.
7

Actual unretouched photographs.

Imagine a microcomputer

Imagine a microcomputer with all the design savvy, ruggedness, and sophistication of the best minicomputers.

Imagine a microcomputer supported by dozens of interface, memory, and processor option boards. One that can be interfaced to an indefinite number of peripheral devices including dual floppy discs, CRT's, line printers, cassette recorders, video displays, paper tape readers, teleprinters, plotters, and custom devices.

Imagine a microcomputer supported by extensive software including Extended BASIC, Disk BASIC, DOS and a complete library of business, developmental, and industrial programs.

Imagine a microcomputer that will do everything a mini will do, only at a fraction of the cost.

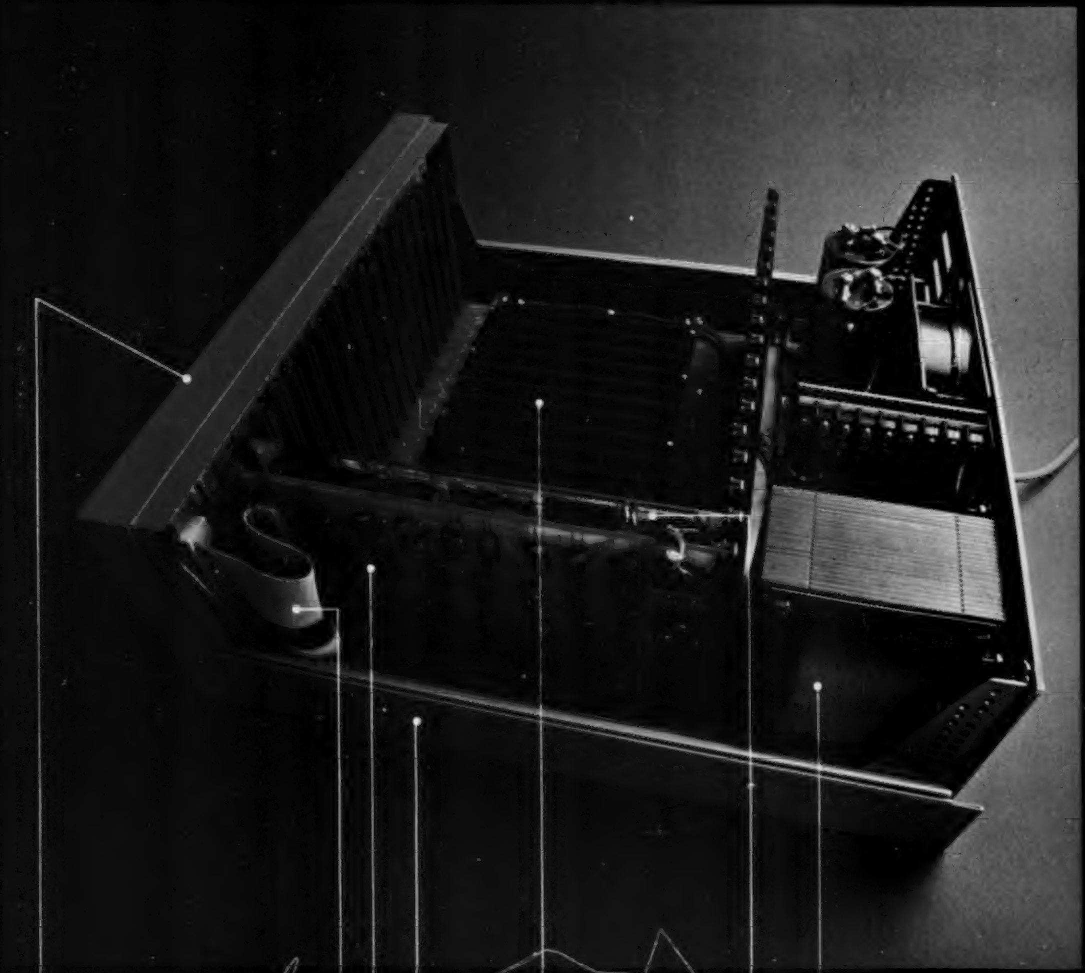
You are imagining the Altair™ 8800b. The Altair 8800b is here today and it may very well be the mainframe of the 70's.

The Altair 8800b is a second generation design of the most popular microcomputer in the field, the Altair 8800. Built around the 8800A microprocessor, the Altair 8800b is an open ended machine that is compatible with all Altair 8800 hardware and software. It can be configured to match most any system need.

Introductory prices for the Altair 8800b are $840 for a kit with complete assembly instructions, and $1100 for an assembled unit. Complete documentation, membership into the Altair Users Club, subscription to "Computer Notes," access to the Altair Software Library, and a copy of Charles J. Sippl's Microcomputer Dictionary are included. BankAmericard or Master Charge accepted for mail order sales. Include $8 for postage and handling.

Shouldn't you know more about the Altair 8800b? Send for our free Altair Information Package or contact one of our many retail Altair Computer Centers.

MITS, Inc. 1976/2450 Alamo S.E./Albuquerque, New Mexico 87106



Redesigned front panel. Totally synchronous logic design. Same switch and LED arrangement as original Altair 8800. New back-lit Duralith (laminated plastic and mylar, bonded to aluminum) dress panel with multi-color graphics. New longer, flat toggle switches. Five new functions stored on front panel PROM including DISPLAY ACCUMULATOR (displays contents of accumulator), LOAD ACCUMULATOR (loads contents of the 8 data switches (A7-AO) into accumulator), OUTPUT ACCUMULATOR (Outputs contents of accumulator to I/O device addressed by the upper 8 address switches), INPUT ACCUMULATOR (inputs to the accumulator from the I/O device), and SLOW (causes program execution at a rate of about 5 cycles per second—for program debugging).

Full 18 slot motherboard.

Rugged, commercial grade Optima cabinet.

New front panel interface board buffers all lines to and from 8800b bus.

Two, 34 conductor ribbon cable assemblies. Connects front panel board to front panel interface board. Eliminates need for complicated front panel/bus wiring.

New, heavy duty power supply: +8 volts at 18 amps, +18 volts at 2 amps, 18 volts at 2 amps. 110 volt or 220 volt operation (50/60 Hz). Primary tapped for either high or low line operation.

New CPU board with 8080A microprocessor and Intel 8224 clock generator and 8216 bus drivers. Clock pulse widths and phasing as well as frequency are crystal controlled. Compatible with all current Altair 8800 software and hardware.

altair 8800-b

mits

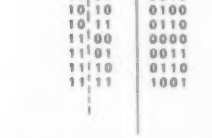
Price, specifications subject to change. Please allow up to 60 days for delivery.

George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

Go Forth and Multiply!

- - the space age approach

A simple 4 bit multiplication algorithm may be implemented on virtually any microprocessor system by simply placing a table of products in memory and then using the multiplier and multiplicand to form a relative address to point to the desired product in the table. This technique produces a fast multiply and does not require separate hardware in order to implement a multiply instruction. Furthermore, by using the fundamental properties of arithmetic, the 4 bit multiply may be expanded to produce an 8 bit or larger multiply instruction. The disadvantage of this fundamental technique is that a four bit multiplication table will require 256 eight bit memory locations.


Multiplier
Multiplicand

4 BIT ADDRESS	4 BIT PRODUCT [contents of memory]
00 00	0000
00 01	0000
00 10	0000
00 11	0000
01 00	0000
01 01	0001
01 10	0010
01 11	0011
10 00	0000
10 01	0010
10 10	0100
10 11	0110
11 00	0000
11 01	0011
11 10	0110
11 11	1001

Fig. 1. Two bit multiplication table.

The algorithms described in this article (both 4 and 8 bit) may be applied to systems lacking a software multiply or they may be used to replace a slower multiply in systems where a multiply instruction already exists.

As an example of multiplication in the binary system, consider multiplication of the two binary numbers 1001 and 1101:

```
Multiplicand ——→    1001   = 9₁₀
Multiplier ————→  x 1101   = 13₁₀
                    ----
                    1001
Partial    {       0000
Products   {      1001
           {     1001
                 -------
Product ———————→ 1110101   = 117₁₀
```

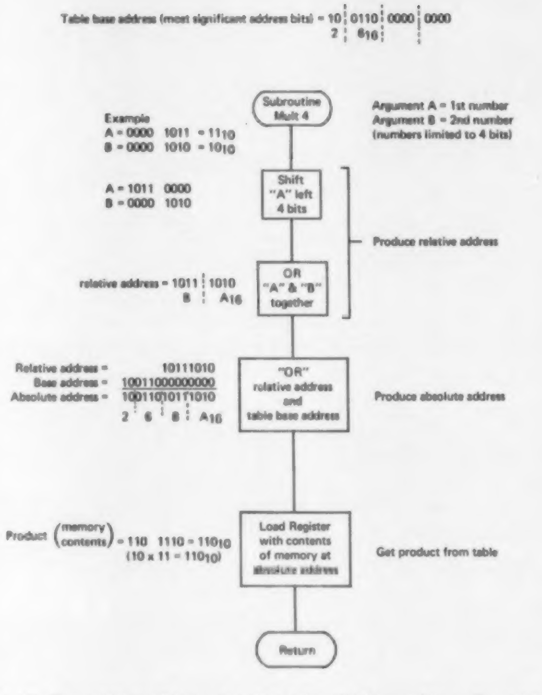


Table base address (most significant address bits) = 10 | 0110 | 0000 | 0000
2 | 6₁₀ |
Subroutine Mult 4
Argument A = 1st number
Argument B = 2nd number
(numbers limited to 4 bits)
Example
A = 0000 1011 = 11₁₀
B = 0000 1010 = 10₁₀
Shift "A" left 4 bits
A = 1011 0000
B = 0000 1010
Produce relative address
OR "A" & "B" together
relative address = 1011 | 1010
B | A₁₆
Relative address = 10111010
Base address = 10011000000000
Absolute address = 10011010111010
2 | 6 | B | A₁₆
"OR" relative address and table base address
Produce absolute address
Product (memory contents) = 110 1110 = 110₁₀
(10 x 11 = 110₁₀)
Load Register with contents of memory at absolute address
Get product from table
Return

Fig. 2. Four bit multiply algorithm for 8 bit machine. Four bit multiplicand and multiplier must be placed into least significant bits of 8 bit word.

The Multiplication Table

The table of products, or multiplication table, is generated very simply by joining a 4 bit multiplier and a 4 bit multiplicand together to form an 8 bit relative address. The 8 bit relative address points to a memory location that contains the product, or result, of multiplying the 2 four bit numbers together.

As an example, consider the 2 bit multiplication table shown in Fig. 1. If we wished to multiply the binary integers 01 and 10 together, we would join the two numbers together to form a relative address of 0110 or 1001. The data contained at either of these relative addresses is 0010, which is the product of the two numbers (1 x 2 = 2).

Setting Up a 4 Bit Multiplication Table

The 4 bit multiplication table is easily set up by multiplying out each product using all combinations of 4 bit numbers. While this sounds time-consuming, it is not, and only involves 256 multiplications. (Some computer manuals may have this table already worked out.)

The multiplication table may be placed anywhere in memory; however, it is convenient to locate the table on a 256 word boundary (the start of a block of 256 words), so that either a logical operation or an arithmetic instruction may be used to generate the absolute address of the product.

Performing the Multiplication

In order to use the multiplication technique described, it is necessary to write a simple subroutine as shown in Fig. 2. In brief, this subroutine accepts 2 four bit numbers, uses them to form an 8 bit relative address, "ORs" in the base address of the table to form an absolute address, and then loads the product into a register from the table. A very minimal number of instructions are needed to perform the entire process.

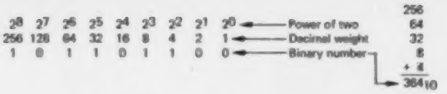

2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
256 128 64 32 16 8 4 2 1
1 0 1 1 0 1 1 0 0
Power of two
Decimal weight
Binary number
256
64
32
8
+ 4
384_{10}

Fig. 3. Powers of two example.

An 8 Bit Multiply

Once the 4 bit multiply has been implemented, the basic properties of arithmetic may be used to generate an algorithm to multiply 2 eight bit or larger integers. To multiply the 2 eight bit numbers A and B together, it is first necessary to break the 8 bit numbers down into 4 bit pieces such that $A = m(2^4) + n$ and $B = q(2^4) + r$, where m and q are the most significant 4 bit portions of the numbers and n and r are the least significant 4 bit portions of the numbers. (See Fig. 3 for powers of two example, if you're in need of a little "refresh" in this area.)

Examples:

$$\begin{array}{lcccc} & m & & n & \\ \text{Multiplicand} & 1\ 1\ 0\ 0 & \vdots & 0\ 1\ 0\ 1 & = 197_{10} \\ \text{Multiplier} & 0\ 1\ 1\ 1 & \vdots & 0\ 0\ 1\ 0 & = 114_{10} \\ & q & & r & \end{array}$$

$$A = m(2^4) + n \longrightarrow A = 12(16) + 5 \quad = 197_{10}$$

$$B = q(2^4) + r \longrightarrow B = 7(16) + 2 \quad = 114_{10}$$

$$\begin{array}{rr} & 197_{10} \\ & \times\ 114_{10} \\ \hline \text{Product} \longrightarrow & 22458_{10} \end{array}$$

It then follows that:

$$A(B) = [m(2^4) + n]\ [q(2^4) + r]$$

Expanding the above expression produces:

$$A(B) = m(q)(2^8) + m(r)(2^4) + n(q)(2^4) + n(r)$$

We see that we can generate this multiplication by performing four bit multiplications, followed by a summation of the products. In the case when a power of 2 is associated with the product, the product must be shifted left n bits, where n is the power of two, prior to the summation. A simple subroutine to perform this 8 bit multiplication could be written as shown in Fig. 4.

Conclusion

The 4 bit multiplication algorithm given in this article may easily be implemented on any 8 bit (or larger) microprocessor system with very little difficulty, provided that the system has an 8 bit register in which to store the 8 bit product. The 8 bit multiplication algorithm, however, produces a 16 bit product, a product which is produced by summing four 16 bit product terms. For easy implementation of this algorithm, the microprocessor should have a 16 bit arithmetic register or a 16 bit software add.

The fundamental 4 bit multiplication algorithm described in this article was intended primarily to be implemented by software, such that the multiplication table would be loaded each time the system was loaded. There is no reason, however, why the multiplication table could not be placed in ROM or PROM and made a permanent part of the system.

The algorithms given in this article were not intended to be the last answer to the problem of providing a multiplication instruction for a microprocessor system. They are intended to provide a viable alternate solution to a problem which can be solved in many ways.

If the microprocessor user is running out of CPU cycles and his system is overloaded due to the use of such a software multiply or other software-implemented instructions, then the user should seriously consider adding additional hardware functions to replace these software routines. ■

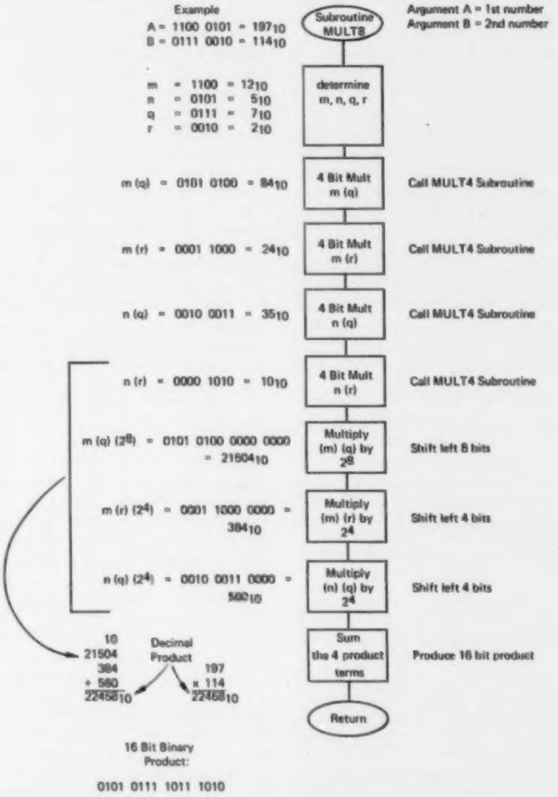

Example
A = 1100 0101 = 197_{10}
B = 0111 0010 = 114_{10}
Subroutine MULT8
Argument A = 1st number
Argument B = 2nd number
m = 1100 = 12_{10}
n = 0101 = 5_{10}
q = 0111 = 7_{10}
r = 0010 = 2_{10}
determine m, n, q, r
m (q) = 0101 0100 = 84_{10}
4 Bit Mult m (q)
Call MULT4 Subroutine
m (r) = 0001 1000 = 24_{10}
4 Bit Mult m (r)
Call MULT4 Subroutine
n (q) = 0010 0011 = 35_{10}
4 Bit Mult n (q)
Call MULT4 Subroutine
n (r) = 0000 1010 = 10_{10}
4 Bit Mult n (r)
Call MULT4 Subroutine
m (q) (2^8) = 0101 0100 0000 0000 = 21504_{10}
Multiply (m) (q) by 2^8
Shift left 8 bits
m (r) (2^4) = 0001 1000 0000 = 384_{10}
Multiply (m) (r) by 2^4
Shift left 4 bits
n (q) (2^4) = 0010 0011 0000 = 560_{10}
Multiply (n) (q) by 2^4
Shift left 4 bits
10
21504
384
+ 560
22458_{10}
Decimal Product
197
x 114
22458_{10}
Sum the 4 product terms
Produce 16 bit product
Return
16 Bit Binary Product:
0101 0111 1011 1010

Fig. 4. Eight bit multiply routine (using 4 bit multiply subroutine).

by John Craig

I/O REPORT

Last month I squeezed in a quick mention of the Faire, and this month I'd like to fill in more of the details. Jim Warren (editor of *Dr. Dobb's Journal*) and Bob Reiling (editor of the Bay Area's Homebrew Computer Club *Newsletter*) are putting together a shindig on the West Coast in April. There are expected to be over 200 commercial and home brew exhibits, along with 100 formal and informal seminars, plus two big banquets.

You've all seen how microprocessors have played a big part in recent hamfests. Here's a "computerfest" that ham radio could play a big part in. One of the conference sessions is being planned around "Computers and Amateur Radio" and there's no reason why this couldn't be a good opportunity to get some computer enthusiasts interested in ham radio. We're going to have to show them what can be done when the two hobbies are combined, though.

If you'd be interested in presenting a talk on ham radio, the organizers would like to hear from you. If you've got your home system doing interesting things with (or without) your ham station, and you can cart it all to San Francisco, then you ought to see about getting a "home brewers" booth. (By the way, they are even offering nominal grants-in-aid to help with exhibit transportation costs. Check into it if you need to.) And, not incidentally, the "home brew" booths are free.

Don't get me wrong and get the impression that ham radio is the only thing you should consider (this just seemed like a good place to emphasize it). There are a multitude of other subjects you might be interested in, and I'll mention some of those next month.

The First West Coast Computer Faire, to be held in the San Francisco Civic Auditorium, April 15, 16, and 17, 1977. For further details call or write: Jim Warren, Faire Chairperson, Box 1579, Palo Alto CA 94302, (415) 851-7664 or 323-3111.

DEDICATED CONTROLLER APPLICATIONS

Almost without exception, every single board computer which has been manufactured and marketed was developed for the digital design engineer to use in dedicated controller applications (boards such as MOS Technology's KIM-1, Intel's SBC-80, National's IMP-16, etc.). For several reasons, I don't think it would be such a bad idea for some of the hardware-oriented hobbyists to start looking at the world around them through the eyes of those design engineers. In other words, start looking for the same applications they are.

Let me give you an idea of what I mean. I once heard an interesting story about a microcomputer engineer who had a neighbor who was in the asphalt business. During a conversation over the backyard fence one day, the road builder was relating to his engineer neighbor one of the problems of his business (which was costing him a lot of money). It seems that during the manufacturing of asphalt it is very important to get all moisture out of the sand/gravel mixture prior to beginning the mixing process. This is accomplished by using kerosene burners mounted under a large tumbler containing the sand/gravel mix. The problem was that these burners kept going, and consuming expensive amounts of kerosene, for some time after the mixture was completely dried out. The engineer recognized this as a problem which could be solved by a microcomputer, some sensors, and some valve controllers. He installed moisture sensors within the tumbler (and I'm still having trouble picturing that) and used the computer to monitor the amount of moisture and control the amount of kerosene going into the burners. And, of course, the burners were turned off at precisely the right time, resulting in significant savings in kerosene. As a matter of fact, the designer derived his "fee" from a royalty based on a percentage of the annual savings the new system offered (compared to the old way of doing it).

We've got a couple of things going for us in this area . . . and a couple against us. First of all (in the "against" department), we all need more exposure to the world of analog-to-digital and digital-to-analog conversion techniques. We haven't seen enough articles on the subject (in any magazine) and it's doubtful that there are a great number of people among our ranks with extensive experience in this area. Those that are should get busy and share some of their knowledge through an article or two. I would think a good place to start would be a publication such as National Semiconductor's *TRANSDUCERS Handbook*. (The handbook covers temperature and pressure transducers and application.)

On the plus side, most of the hams who are into computers have sufficient electronics background to pick up the necessary information on A/D and D/A applications and the interfacing to a computer. Also, we're going to be seeing articles on some *very* low cost single board computers in upcoming pages of *73* and *Kilobaud*. Some of these boards can be built for as little as $50 to $100 (quite an improvement over the $250 to $450 range we're normally faced with from the commercial versions). And, one more plus . . . the hobbyist isn't going to have to go through the "trauma" of having to learn how to program his microprocessor. He's already been there!

QUANTITY PURCHASING

A friend of mine is building a low cost 132 column line printer which should have quite an effect on the hobbyist and small business computer market. Just like anyone else attempting a project such as this, he's having his problems getting financial backing for the venture. In the process of putting together a cost analysis package (to show to prospective backers), he ran across some interesting things which are worth sharing with you.

One of his objectives in putting together this package was to itemize each component that goes into the printer and put down the single quantity price, the quantity price (100), and the total cost per unit for that component (based on the number required for each unit). After getting all this information down, he could then very easily add it all up and come up with a cost-per-unit based upon single quantity purchasing versus quantity buying (he knew that one was going to be quite a bit less . . . he just wanted to see how much).

He quite naturally assumed (as did I) that the best way to go about getting the lowest prices for the various components would be through OEM price lists. We were both in for a surprise. Here's an example of what he came up with on integrated circuit prices using a Signetics and National Semiconductor OEM price list:

	1 to 24	100 to 999
Signetics – 7400 DIP	$.51	$.34
National – 7400 DIP	.55	.35
Signetics – 7474 DIP	$.78	$.52
National – 7474 DIP	.88	.54

The above information certainly doesn't contain any earth-shattering news (except to show my friend the slight price difference between the two). But . . . and look out, here comes the good part . . . after getting the whole package together he happened to glance at the James and Godbout ads in *73* and suddenly discovered what low prices really are! Here's the way they stack up with regard to the two ICs picked at random:

Godbout – 7474 DIP	.36
James – 7474 DIP	.32
Godbout – 7400 DIP	$.18
James – 7400 DIP	.16

And those are single quantity prices!! Rather incredible, right? Well, you ain't seen nothin' yet! Both Godbout and James offer a *20%* discount on orders of 100 or more!

Normally I'm pretty level-headed and don't get too excited about such things, but this really intrigued me. Furthermore, it occurred to me that a lot of other people out there in hobbyville and small businessland might make the same mistake (using OEM price lists) when getting ready to manufacture things. Therefore, I decided to do some checking into the situation and find out just what was going on. A phone call to Bill Godbout cleared it all up. Very simply, if you're going to be buying ICs in the hundreds of thousands, such as Godbout and James do, then the manufacturer brings out an entirely different price list than the one my friend had. But the most important point he brought out is that the chips he and James (and most of the other large volume dealers) are selling are full-spec ICs. Your first impression after seeing the large difference in those prices is that the dealers must be selling something other than quality material. Not so.

MISCELLANEOUS

About a year ago I subscribed to *Ham Radio* and *QST* for the express purpose of keeping track of the "competition" and their coverage of the computer hobbyist/microcomputer applications area. Each month when those magazines arrived it became more and more obvious that I had wasted my money. But, I hate to just throw them away . . . after all, there's very likely somebody, somewhere, who would like to have them. I think perhaps they'll be going with me to the next ham swap.

Quite often I have people ask me about the opportunities for getting into computer programming and/or maintenance through the experience they've gained "working" with a hobby system. I wouldn't want to discourage anyone, but I think such an approach would depend an awful lot on the individual and his plan of attack. The idea is not too terribly farfetched, though. I glance through the Sunday *Los Angeles Times* classifieds every now and then to keep track of anything that might have a bearing on the computer hobbyist field. It's interesting to note that I've been seeing more and more ads for microcomputer-experienced personnel. By "more and more," I mean 4, 5, or 6 each Sunday . . . compared to none a year and a half ago.

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How to Find a Forgetful Memory

- - diagnostics for a thoughtless computer

Symbolic Address	Location	Machine Code	Mnemonic	Comments
DEBUG	043-200	021	LXI D	Set TW pointer
TWP	201	xxx		to start of block
	202	yyy		to be tested
	203	006	MVI B	Load reg B
TW	204	377 (000)		with test word
	205	353	XCHG	Switch regs D-E & H-L
NEXT	206	160	MOV M,B	Load reg M with TW
	207	353	XCHG	Switch regs D-E & H-L
	210	041	LXI H	Set FW pointer
FWP	211	xxx		to start of block
	212	yyy		to be tested
LOAD	213	175	MOV A,L	Test to make sure
	214	273	CMP E	FW isn't loaded into
	215	302	JNZ	same addr as TW
	216	225	OK	
	217	043		
	220	174	MOV A,H	Still testing to
	221	272	CMP D	make sure FW isn't
	222	312	JZ	loaded into same
	223	227	SKIP	addr as TW
	224	043		
OK	225	066	MVI M	Load reg. M
FW	226	000 (377)		with FW
SKIP	227	043	INX H	Advance FW pointer
	230	174	MOV A,H	Test to see if FW pointer
	231	376	CPI	is at start of next block
NB	232	nnn		Page number of next block
	233	302	JNZ	No, continue loading FW
	234	213	LOAD	
	235	043		
TEST	236	353	XCHG	Switch regs D-E & H-L
	237	176	MOV A,M	Retrieve stored TW
	240	270	CMP B	Has stored TW changed?
	241	304	CNZ	Yes, call ERROR routine
	242	277	ERROR	
	243	043		
	244	043	INX H	Advance TW pointer
	245	174	MOV A,H	Test to see if TW pointer
	246	376	CPI	is at start of next block
NB	247	nnn		Page number of next block
	250	302	JNZ	No, go back and load TW
	251	206	NEXT	into next addr in this block
	252	043		
LOOP	253	076	MVI A	Fetch loop counter value
LCV	254	010		from addr 254
	255	075	DCR A	Decrement LCV
	200-256	312	JZ	LCV=0?
	257	267	DONE	Yes – have tested whole block
	260	043		"LCV" times, so jump to DONE
	261	062	STA	Store the loop counter value
	262	254		in LCV
	263	043		
	264	303	JMP	Make next pass through
	265	200	DEBUG	the program for the
	266	043		present block under test
DONE	267	076	MVI A	Reset the loop counter
	270	010		value
	271	062	STA	Store the loop counter
	272	254	LCV	in LCV
	273	043		
	274	303	JMP	Jump back to
	275	bbb	MONITOR	your MONITOR
	276	ccc		
ERROR	277	305	PUSH B	Save the TW on the stack
	300	114	MOV C,H	Move page number to reg C
	301	315	CALL	Output the page
	302	ddd	OCTOUT	via your octal conversion
	303	eee		and print routine
	304	115	MOV C,L	Move addr to reg C
	305	315	CALL	Output the address
	306	ddd	OCTOUT	
	307	eee		
	310	116	MOV C,M	Move the errant TW to reg C
	311	315	CALL	Output the errant TW
	312	ddd	OCTOUT	
	313	eee		
	314	315	CALL	Output A
	315	fff	CRLF	carriage return and
	316	ggg		line feed
	317	301	POP B	Retrieve TW from the stack
	320	311	RET	Return to main program

Table 1. The improved memory diagnostic program. Note that the programmer must initialize "TWP", "FWP", and "NB" according to the block memory he wishes to test.

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Canada N0M 2V0

In a recent article (*73 Magazine*, Oct., 1976, p. 114), I described a simple memory diagnostic program for 8080-based systems and illustrated its use in troubleshooting 4K memory boards. While that method is effective for localizing gross defects, such as chips which have one or more bits permanently set, more subtle defects may evade detection. For example, after discovering 4 bad chips in 8K of memory, by the simple techniques described in my previous article, I attempted to load and run "SCELBAL" – but to no avail. After many hours of checking and reloading scattered addresses with the correct contents, it dawned on me that when I corrected the contents of some addresses I was sometimes changing the contents of other addresses. What obviously was needed was a more thorough memory "debugging" approach. This article, I believe, brings us one step closer to that end, and "SCELBAL" is now running fine.

The simple methods which I outlined in the previous article employ two basic techniques. One technique takes the value of an address and loads it as a data word into that same address. This is done for all 256 addresses on a page. Next, the values of the addresses are compared with their respective contents. If they are dissimilar, an error printout is produced. For example, if the eighth data bit (bit 7) at address 023 is always set to 1 due to a chip defect, the actual contents of that address will be 223, which would generate an error. However, if bit 0 of address 023 was always set to 1, no error would be detected. Needless to say, this would cause problems in an actual program which required that bit 0 at address 023 be set to 0.

One way that the above problem can be overcome is to use a slightly different approach. Typically, this second technique loads a random number into all ¼K addresses of a page and then sequentially examines the contents of the 256 addresses to see if they still contain the pattern which was loaded into them. If enough random patterns are tried, a bit at some given address which is permanently set will sooner or later be discovered. However, a not uncommon problem is for 2 or more addresses to interact. If addresses 023 and 025 were interacting in such a manner that whatever was loaded into bit 7 at address 025 changed the corresponding bit in address 023, then this second technique would not detect the error by virtue of the fact that the whole page was loaded with the identical data word.

As if the above wasn't trouble enough, programs which check only one page of 256 addresses at a time are unable to detect interactions between 2 or more of the 4 blocks of 256 bits which actually reside on a single 2102 type memory chip.

The program described in this article overcomes the shortcomings listed above, and when fully implemented provides a potent tool for detecting memory problems. In order to make maximum use of the procedure, I recommend that you read my earlier article in order to understand the functional layout of a typical 4K board of 2102 chips.

About the Program

In my system, the program, which is listed in Table 1, resides on page 043, address 200-320 (octal). Relocation should provide little difficulty once the mechanics of the program are understood.

The program loads a Test Word (TW), either 377 or 000 (octal), into one address in a 1K segment of the board. It then fills the remaining addresses of the 4 pages with a Field Word (FW), either 000 or 377 (the complement of the TW). When the 4 pages have been filled with the FW, the program retrieves the TW which was previously stored in memory and examines it to see if it was altered. If the TW has been altered, an error printout will be produced. If no error has occurred at that address, the next sequential address is loaded with the TW while all other addresses are loaded with the FW. Then the stored TW is once again tested. This process is repeated until each address in the 4 page block has been tested.

The program repeats the above procedure eight times (your option). The reason for repeatedly testing a 4 page block is that the repeated accessing of a particular area in memory will generate additional heat, consequently increasing the chance that marginal chips with thermal defects will be detected.

The programmer then sets up the program to check the next block of 4 pages on a board, until the whole board has been checked. In order to keep the program simple for beginners like myself, I opted to have the programmer initialize each successive 4 page block; obviously the computer could be made to do it, albeit at the cost of making the program more complex and harder to follow. After checking out the whole board, the programmer should change the TW and FW to the values given in brackets in the program, and then test the whole board again. You may encounter a situation where the 377 test word won't be altered by an interaction with a 000 field word, but a 000 TW will be altered by a 377 FW.

```
020 167 375     020 134 010
020 222 376     020 135 020
021 026 177     023 163 100
022 140 337     023 272 004
```

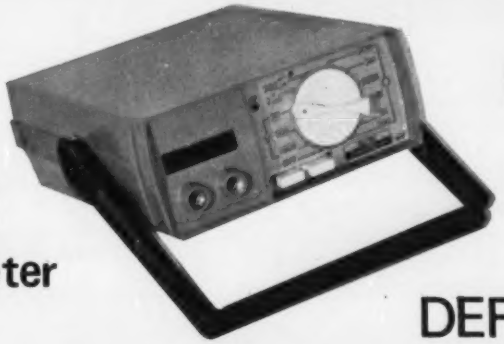
Table 2. A typical printout from "DEBUG." Test word for the left-hand column was 377, while the test word for the right-hand column was 000.

Table 2 illustrates a typical printout. Note that the page, address, and incorrect data are outputted. As in the previous program, this program assumes the existence of an octal conversion and print routine ("OCTOUT") which it can call.

A Few Tips

When you are making the test, do it once or twice with the case off the computer when it is relatively cool. Then put the case on and run through the procedure with the computer thoroughly warmed up. I found 4 defective chips with the program when testing cool, and 4 more when testing hot. What really blew my mind was that two of the cool defects showed up only sporadically under the hot condition. Also, this is a time when effective use can be made of the spray-type component coolers. You might also wish to sandwich the memory board(s) between other boards in order to entrap the heat.

I hope you find the present techniques as valuable as I have. Happy troubleshooting. ■



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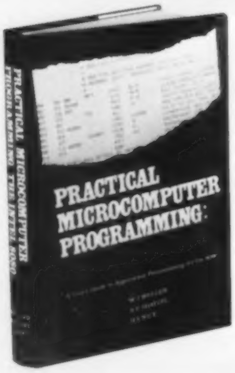

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A Super Log

-- a program for the ham shack computer

Most software articles I'm finding in all the popular magazines are written in software language, which I have a heck of a time understanding. I'm just a radio amateur, not a computer genius. So it takes a little more detailed explanation for me to understand what's going on. However, I have a little business of my own and to help my business I purchased a SWTPC 6800 computer kit. Once I got the machine together, I was most anxious to put it to work for my business. And that's where I gained a little software knowledge. After writing the program for my business, I thought it would be interesting to present the same program, with a few changes, to my fellow hams. So, here it is.

The object of this article is to give you a logkeeping program and to explain how the program works. You may not have a 6800 microprocessor yourself or may want to develop the program for your IMSAI or MITS computer. Or, you may not even have a computer and perhaps just want to know more about software. If you have a Motorola 6800 microprocessor and you are a radio amateur, the program listing at the end of the article is for you. This program does a few unique things and can be modified just like an electronic circuit to best suit your personal needs. First of all, we'll spend some time talking about the basic concept of the computer program and what it is supposed to do so you can have a little better understanding of what's going on. Then we'll talk about the details of the Amateur Computerized Logkeeping Program.

Before we jump right into the meat of the article, I should tell you a few things about the program and how it operates and exactly what it can do for you. To begin with, it's a *Search* program. It will search for data entered in memory, by using the first three characters entered. It's not an alphabetic search; it simply uses the first three characters, which can be alpha, numeric, or anything you want. This is a natural for amateur radio calls since the *last* three letters of any callsign are different for each amateur station. (While indeed it is possible to have a WA7SCB, a K7SCB, a K6SCB, etc., odds are against working a bunch of hams with the same last three letters.) A typical input to the computer might be that shown in the photos. Note the call letters start on one line and the state begins on the other. Thus, the computer can search for the call letters, or the state, or for whatever is on one line. There are also some entry and change programs that allow you to delete entire lines of data, thus removing someone from the logkeeping memory. If your computer has a cassette interface, there is a program to store logs on digital cassettes and read them out on a later date if you need to, to produce hard copy on a teletype or line printer.

The only character that can be accessed directly by the keyboard without punching another button is S. S is the key that tells the program to go into the search routine. The computer will come back with CALL? You then insert the last three letters of the call followed by a period. The period causes the program to start running and the computer searches through memory. Any time your processor comes to a line of information that starts with the three letters that you punched in, it will print them on the screen of the CRT. You then can ask for any other listings that start with those three letters by pushing any other character on the keyboard (preferably line feed — makes for a neater display). Or, you may go back to the main program by punching a Y, telling the computer, "Yes, this is the guy I was looking for." You may *Enter* data by holding down the control button and then punching the letter E. If no more memory positions are available, the computer will come back with FULL (not all of us can afford 64K); if there are memory positions available the com-

```
LOAD ACCUMULATOR "A" (IN HEX)

      LDA A:

          IMMEDIATE - 86 XX (XX is data)
          DIRECT - 96 XX (XX is address 00 XX)
          INDEXED - A6 XX (XX is amount of offset from "index" contents)
          EXTENDED - B6 XX XX (XXXX is full address)
```

Fig. 1. 6800 addressing methods, using "Load Accumulator A" instruction as an example.

FREQUENCY COUNTER
Hufco
SWTP 6800 COMPUTER SYSTEM

The WA7SCB station.

puter will respond with CALL? You then enter the data that you wish to be stored, formatting it as shown in Table 1. (Of course, you may use your own format, but you do need to standardize. This way you'll be able to search for the data again at some later date.) After you have entered all the desired data, press the period. The period then terminates the Enter Routine and the computer sends "*73s". Those of you who do not go along with saying "73s" in its plural form simply change the program to say "73" or "blank" or "thanks" or whatever you want.

The third mode the computer operates in is *Change.* When you push control C, the computer comes back with CALL? You then enter the first three letters and hit a period. The computer searches for the data, then prints out a line of data on the screen. If the line shown is not the one you wish to change, just push line feed, and the computer will search for the next entry in your computerized log that has the same first three letters. As soon as you come to the call letter that is the one that you wish to change, depress Y which activates the CALL? response. Now you can reenter data. To delete the entry, all you do is enter a space and a period. This is because in the Enter Routine the computer is searching for spaces in memory. If it finds anything but a space at the beginning of a line, it assumes that there is some valid data there and goes to the next line of data in memory. Thus, inserting a space as the first character in a line of data in memory will delete the entire line of data. The next time you use the Enter Routine, the computer will find that space, and your new data will write over the old line in memory.

Obviously, if the computer is looking for spaces in memory, the first thing that we have to do is to stuff spaces in memory. We have a program to do that and it is called *Load Up* (with spaces) routine. You have enough open memory positions to store as much data as your configuration is capable of handling. Of course, you could just put a space in every 32nd character (the beginning of a line in memory).

Any time a wrong character is punched on the keyboard, the computer says "GOOF!" It can say anything else you'd like it to say, but GOOF was convenient and doesn't take much memory.

Programming — General

As I said, I am a radio amateur and not really a computer programmer. In order to make my computer work, I had to first learn what was going on inside. It's simple enough to understand. There are three basic parts to a computer: the I/O, the processor, and the memory. The function of the I/O is pretty simple. It's a way to input and output data from your computer. The function of memory is simple too. It remembers. That's all there is to it! It's the microprocessor that's tricky. The microprocessor is a collection of registers, decoders, timing circuits, and whatever else it takes to perform the functions of decoding information from memory. The microprocessor is a programmable AND gate, OR gate, Adder, Subtractor, Shift Register, etc.

A typical microprocessor has several registers inside it. These registers are used for temporary data storage, manipulating data, shifting bits around timing, decoding, etc. The 6800 is a typical microprocessor with several registers. It has two registers called accumulators (the A accumulator and the B accumulator), which are nothing more than 8-bit data registers. A hexadecimal B6 is the com-

Front view of the home brew terminal.

mand to "load Accumulator A." It's called *Load Accumulator A Extended* because it tells the microprocessor there is an address to follow. The 6800 also has some other modes of operation; for example, it's possible to load the A Accumulator from an address specified in another register in the 6800. The other register is called the *Index Register.* The command *Load Accumulator A Indexed* can also contain offset so that you may either add or subtract from the number that is the index register for your memory address. Another mode of loading the accumulator with data is the direct mode. The direct mode is limited because it is only a 2-bit address. Thus, the highest number you can specify is address FF, which amounts to 265 memory positions. There's still another mode of loading the accumulator, the immediate mode. In the immediate mode, the accumulator is loaded with whatever data is in the location "immediately" following the instruction. The accumulator is told to be loaded and then is given a number to be loaded with. Fig. 1 shows the modes of putting data in the accumulator.

Mnemonics are aids to help us remember things. It's pretty tough to remember C6, A6 or B6 but fairly easy to remember Load Accumulator A, or its mnemonic, LDA A. If a person has an *assembler,* a program can be generated using just these mnemonics (i.e., no hexadecimal or octal numbers punched in at all). Typing in STA B SWER would result in storing the B accumulator in a location which has a symbolic name of SWER (somewhere). In our machine-language coding the mnemonics simply serve as memory aids for the instructions (and symbolic names for addresses are not used).

Without some way to talk to it, the computer is a pretty useless device. The read only memory in the SWTP 6800 computer is nifty because the first thing that happens when power is applied is that a Power Up Routine is executed and the computer prints an asterisk (a *prompt* character) on the screen of the CRT or teletype. The SWTP computer then recognizes the commands L, M, P and G. The M command (modify) allows the loading of programs into memory. With the L command you may load the programs from a punched tape, and the P command will cause paper tapes to be punched. The G command starts a program that has been loaded into the computer. The G command makes the computer begin at whatever step has been designated as the beginning step for your particular computer program.

The Ham Computerized Log: A Blow by Blow Description

The program is written in sections. The first piece is the main routine. This routine is responsible for recognizing various command characters entered at the keyboard. Those are S, Control E and Control C. Any other character entry will get an error message (GOOF!). Other programs include the Enter Routine, which starts at a certain point in memory (specified by you), then checks that point, and every 32 characters beyond, for a space (hexadecimal 20). When it finds a space, it requests your input of data which will then be written on that 32 character line of memory. If the enter program searches beyond your specified memory point and cannot find a space, it concludes memory is full and sends you a "FULL" message.

The Search Routine takes your keyboard entry of three characters and then searches through memory on a bit-by-bit basis beginning at character position 0 and checking every 32 characters thereafter. It will look for the first character that you typed in at character position 0, 32, 64, etc. As soon as the routine finds a match, it skips to the next character and checks that for a match. If there is no match, the routine proceeds to the next 32 character set. If it finds a match it checks the third character and if this matches also, the program assumes this is the correct character combination and prints the entire message.

The Change Program is entered by pressing control C. It does everything the Search Program does except that it jumps back into the Enter Routine once it finds the correct line. You can enter

```
INITIALLY:
        M   A048   ENT SP [illegible]
            A049   ENT SP [illegible]
            A04A   ENT SP C0
        Press G -computer says "G".
        Press Y -computer says "GOOF!"
        If all is well, computer will checkout OK and is ready to use.


TO USE:


      TO ENTER A NAME:
            Press E-computer says "CALL?"
            Type in name-first three letters duplicate, others okay
            to abbreviate.
            At end of entry, hit the period.
            Computer says "*73s."
      TO FIND A NAME:
            Hit S, computer says "CALL?"
            Enter name or first three letters, then a period.
            Computer searches and prints.
                  A. If name is correct, hit Y.
                  B. If name is wrong, hit SP.
      TO CHANGE AN ENTRY:
            First search to insure it's there
            If OK, hit C, computer says "CALL?"
                  Enter first three, then a period.
                  Enter "Y" or SP.
            Computer gives new name or prints "CALL?"
                  Enter changes (delete by SP then hit period
                  Computer says "*73s."
```

Table 1. Program operating commands.

MAIN ROUTINE

```
          MACHINE  SYMBOLIC
LOCATION   CODE    ADDRESS     MNEMONIC                  COMMENTS
 0000       BD                 JSR INEEE                 MIKBUG CHARA IN ROUTINE
                                                         PUTS CHARA IN ACCUM A.
   01       E1
   02       AC
   03       C6                 LDA B    Ctl. "E"         LOAD B WITH CONTROL E
                                                         TO COMPARE WITH 4.
   04       05
   05       11                 CBA                       COMPARE B & A
   06       27                 BEQ                       BRANCH IF EQUAL TO "ENTER"
   07       18
   08       C6                 LDA B "S"
   09       53
   0A       11                 CBA                       COMPARE A WITH "S".
   0B       27                 BEQ                       IF EQUAL GOTO "SEARCH"
   0C       65
   0D       C6                 LDA B Ctl. "C"
   0E       03
   0F       11                 CBA                       COMPARE A WITH "CTLC"

 0010       27                 BEQ                       IF EQUAL GOTO "EDIT"
   11       63
   12       CE                 LDX IMM                   0160
   13       01
   14       60
   15       FF                 STX                       MESSAGE START LOOK UP,
                                                         A04C.
   16       A0
   17       4C
   18       BD                 JSR "OUTLINE"             COMPUTER SEZ "GOOF!"
   19       00
   1A       A0
   1B       7E                 JMP TO MAIN BEGIN
   1C       00
   1D       00
   1E       01 )               STARTING MEM. LOCATION    PRELOADED BY USER. CONTAINS
               }                                         ADDRESS WHERE FIRST DATA
                                                         WILL BE LOADED
 001F       80 )
ENTER ROUTINE
 0020       FE "ENTER"         LDX WITH STARTING
                               MEM LOCATION
   21       00
   22       1E
   23       C6 "ANOTHER"       LDA B WITH SPACE
   24       20
   25       A6                 LDA A INDEXED             FIRST CHARA IN MEM.
   26       00
   27       11                 CBA                       COMPARE SP & FIRST CHARA
   28       26                 BNE                       BRANCH NOT EQUAL TO "LOOKY".
   29       23
   2A       BD                 JSR                       JUMP TO "NAME" SUBR
   2B       A0
   2C       50
   2D       FE                 LDX BACK FROM TEMP.       STORAGE
   2E       00
   2F       70

 0030       01
   31       01
   32       01
   33       BD ANOTHER         JSR INEEE                 MIKBUG CHARA IN SUBR.
   34       E1
   35       AC
   36       A7                 STA A INDEX               PUT A IN MEMORY LOCATION
   37       00
   38       C6                 LDA B (.)                 PUT (.) IN B
   39       2E
   3A       11                 CBA                       IS CHARA A (.)?
   3B       27                 BEQ                       BRANCH IF EQUAL "FIN"
   3C       04
   3D       08                 INX
   3E       7E                 JMP BACK "ANOTHER"
   3F       00                                           GET ANOTHER CHARA &
                                                         PUT IN MEM LOCA X.
 0040       33
 0041       CE "FIN"           LDX WITH MESS START
   42       01
   43       30
   44       FF                 STX IN REGIS              START OF MESSAGE IN A04C.
   45       A0
   46       4C
   47       BD                 JSR "OUTLINE" COMPUTER
                               SEZ "73's"
   48       00
   49       A0
   4A       7E                 JMP BACK TO MAIN
   4B       00
   4C       00
   4D       C6 "LOOKY"         STA B 20_16(32_10)        PUT LINE LENGTH IN B
   4E       20
   4F       08 LOOP            INX                       LOOP - INCREMENTS INDEX
                                                         REGISTER 32 TIMES.
 0050       5A                 DEC B
   51       2F                 BLE B ≤0?
   52       03
   53       7E                 JMP BACK FOR SUMMORE      TO "LOOP".
   54       00
   55       4F
   56       FF                 STX                       STX IN TEMP.
   57       00
   58       70
   59       C6                 LDA B W                   LAST MEM ADR MSB

   5A       0F
   5B       B6                 LDA A WITH MSB INDEX REG
   5C       00
   5D       70
   5E       11                 CBA                       LAST MEMORY YET?
   5F       2E                 BGT                       IF YES BRANCH TO "BIG".

 0060       03
   61       7E                 JMP BACK AGAIN -
                               "ANOTHER" LOOK.
```

```
   62       00
   63       23
 0064       CE BIG             LDX DIR WITH MESS
   65       01
   66       70
   67       FF                 STX                       IN A04C FOR MESS START.
   68       A0
   69       4C

   6A       BD                 JSR OUTLINE COMPUTER
                               SEZ "FULL"
   6B       00
   6C       A0
   6D       7E                 JUMP TO MAIN
   6E       00
 006F       00

   70       00                 TEMP X STORE
   71       00

 0072       7E                 JMP                     } BRIDGE FROM MAIN PGM TO
   73       00                                         } SEARCH SUBR.
   74       CA                                         }

 A050       FF "NAME"          STX TEMP.                 HOLD X IN TEMP STORAGE.
   51       00
   52       70
   53       CE                 LDX MESS START
   54       01
   55       68
   56       FF                 STX A04C                  MESSAGE BEGIN REGIS A04C.
   57       A0
   58       4C
   59       BD                 JSR "OUTMESS'             COMPUTER SEZ "CALL?"

   5A       00
   5B       A0
 A05C       39                 RTS
EDIT ROUTINE
 0075       CE "EDIT"          LDX IM MESS               STARTING MESSAGE ADDRESS.
   76       01
   77       68
   78       FF                 STX MESS                  A04C FOR LOOKUP
   79       A0

   7A       4C
   7B       BD                 JSR OUTLINE COMPUTER
                               SEZ "CALL"
   7C       00
   7D       A0
   7E       CE                 LDX IM TEMP LINE START
                               ADR
   7F       01

 0080       40
   81       BD                 JSR INEEE                 MIKBUG CHARA IN ROUTINE
   82       E1
   83       AC
   84       A7                 STA A INX'D               PUTS INPUT CHARA IN BUFFER
   85       00 ALDX
   86       C6                 LDA B (.)                 PUT (.) IN ACCUM B
   87       2E
   88       11                 CBA                       COMPARE B AND A
   89       26                 BNE                       NOT EQUAL BRANCH TO "SUMMORE"

   8A       09
   8B       BD                 JSR "SEARCH CHARA"        FINDS MATCHING CHARACTERS
   8C       00
   8D       F0
   8E       7F                 CLEAR ALDX
   8F       00

 0090       85
   91       7E                 JMP TO "ENTER"            ALLOWS DATA ENTRY
   92       00
   93       2A
   94       7C SUMMORE         INC A LDX
   95       00
   96       85
   97       7E                 JMP & LOAD ANOTHER
                               TO TEMP LINE
   98       00
   99       81

OUTLINE SUBROUTINE
 00A0       FF OUTLINE         STX TEMP                  KEEP CONT OF IND REG IN A04E.
   A1       A0
   A2       4E
   A3       FE                 LDX A04C (CHAR START)     GET LINE STARTING
                                                         ADR FROM A04C.
   A4       A0
   A5       4C
   A6       A6 ANOTHER         LDA A X'd                 PUT 1ST CHARA IN ACCUM A.
   A7       00 LDAX
   A8       C6                 LDA B (.)
   A9       2E

   AA       11                 CBA                       COMPARE A TO A (.)
   AB       27                 BEQ                       BRANCH IF EQUAL TO CRLF.
   AC       09
   AD       BD                 JSR OUTEEE                MIKBUG CHARA OUT ROUT.
   AE       E1
   AF       D1

 00B0       7C                 INCR LDAX
   B1       00
   B2       A7
   B3       7E                 JMP TO                    "ANOTHER"
   B4       00
   B5       A6
   B6       7F CRLF            CLR AX'd
   B7       00
   B8       A7
   B9       86                 LDA A LF                  LOAD ACCUM A WITH LF.
```

the new data, changing whatever data is in the 32 character line of memory.

There are two main subroutines. One is the Search Character Subroutine (this is used by the change program and the search program). The Search Character Subroutine looks for a particular character until it finds a match in memory, then holds the memory location in the index register.

The other is the Outline Subroutine. This one is used in conjunction with a temporary memory position to output various messages to the operator. Once your messages have been entered in a given place in memory, the Outline Subroutine will print them on the screen whenever you call for them.

Terminators for all the routines are periods. When the computer sees a period it will know that is the end of an entry or that it is the end of a line of memory.

Quirks, Problems and General Points of Interest

Let's go to the beginning. The main routine is located at 0000 and goes through 001F. If you are an SWTP purist who is obeying the manual's suggestions, you may want to put the main routine somewhere else. The SWTP books suggest you leave locations 0000-0020 open for future floppy disc interface. It's easy to move the main routine. Also, you may not like the computer recognizing S, CTL

```
    BA      0A
    BB      BD                 JSR OUTEEE              MIKBUG CHARA OUT ROUT.
    BC      E1
    BD      D1
    BE      86                 LDA A CR                LOAD ACCUM A WITH CR.
    BF      0D

  00C0      BD                 JSR OUTEEE              MIKBUG CHARA OUT ROUT.
    C1      E1
    C2      D1
    C3      FE                 LDX TEMP                PUT ORIGINAL DATA BACK
                                                       IN INDEX REG.
    C4      A0
    C5      4E
    C6      39                 RTS
```

SEARCH ROUTINE

```
  00CA      CE SEARCH          LDX MESS START          STARTING MESSAGE ADDRESS.
    CB      01
    CC      68
    CD      FF                 STX START REG           PUT START MESS IN A04C.
    CE      A0
    CF      4C

    D0      BD                 JSR OUTLINE COMPUTER
                               SEZ "CALL?"
    D1      00
    D2      A0
    D3      CE                 LDX TEMP LINE           LOAD INDEX REGIS WITH
                                                       FIRST BUFFER ADDRESS.
    D4      01
    D5      40
    D6      BD GET ANOTHER     JSR INEEE               MIKBUG CHARACTER IN.
    D7      E1
    D8      AC
    D9      A7                 STA A INX               STORE CHARA IN BUFFER.

    DA      00 AX'D
    DB      C6                 LDA B (.)               PUT (.) IN ACCUM B.
    DC      2E
    DD      11                 CBA                     COMPARE A WITH (.).
    DE      26                 BNE                     BRANCH NOT EQUAL "ANOTHER"
    DF      09

  00E0      BD                 JSR CHARA               SEARCH FOR CHARACTER SUBROUT.
    E1      00
    E2      F0
    E3      7F                 CLR AX'D
    E4      00
    E5      DA
    E6      7E                 JMP--MAIN
    E7      00
    E8      00
    E9      7C ANOTHER         INCR AX'D

    EA      00
    EB      DA
    EC      7E                 JUMP--GET ANOTHER
    ED      00
    EE      D6
```

SEARCH CHARACTER SUBROUTINE

```
  00F0      FE CHARA           LDX 1st MEM CHARA       FIRST MEMORY DATA STORAGE
                                                       ADDRESS.
    F1      00
    F2      1E
    F3      01                 NOP
    F4      F6                 LDA B 1st CHARA IN
                               TEMP LINE
    F5      01
    F6      40
    F7      A6                 LDA A INX 0             A HAS 1ST MEM DATA.
    F8      00
    F9      11                 CBA                     ARE MEM CHARA AND ENTERED
                                                       DATA SAME?
    FA      26                 BNE                     NO: TO "20"
    FB      1F
    FC      F6                 LDA B 2nd CHARA IN
                               TEMP LINE
    FD      01
    FE      41
  00FF      A6                 LDA A INX 1             2ND CHARA MEM.

  0100      01
    01      11                 CBA                     2ND CHARA COMPARE?
    02      26                 BNE                     NO: TO "20"
    03      17
    04      F6                 LDA B 3rd CHARA
                               TEMP LINE
    05      01
    06      42
  0107      A6                 LDA A INX 2             3RD CHARA COMPARE?
  0108      02
    09      11                 CBA                     3RD CHARA COMPARE?

    0A      26                 BNE                     NO: TO "20".
    0B      0F
    0C      FF                 STX IN TEMP LINE        YES PUT STARTING
                                                       ADDRESS IN A04C.
    0D      A0
    0E      4C
    0F      BD                 JSR "OUTLINE" COMPUTER
                               PRINTS FROM MEMORY

  0110      00
    11      A0
    12      BD                 JSR INEEE               MIKBUG IN CHARA.
    13      E1
    14      AC

  0115      C6                 LDA B "Y"
    16      59
    17      11                 CBA                     IS IN CHARA Y (YES)?
    18      26                 BNE                     NO: "20"
    19      01

    1A      39                 OR RTS TO MAIN RTN IF OK
  011B      C6 "20"            LDA B WITH 32_10        GO TO NEXT STARTING
                                                       MEM LOCATION. PUT 32_10
                                                       IN ACCUM B.
    1C      20
    1D      08 LOOK AGAIN      INX
    1E      5A                 DEC B
    1F      2F                 BLE                     COUNTDOWN DONE? TO "HERE"

    20      03
    21      7E                 JMP BACK--LOOK AGAIN
    22      01
    23      1D
    24      FF HERE            STX TEMP
    25      01
    26      3E
    27      C6                 LDA B WITH 07_16        (OR HIGHEST NUMBER OF
                                                       SEARCH).
    28      10
    29      B6                 LDA A WITH MSB OF X REG

    2A      01
    2B      3E
    2C      11                 CBA                     HIGHEST LEVEL REACHED?
    2D      2E                 BGT                     YES, TO "DONE".
    2E      03
    2F      7E                 JMP BACK LOOK ANOTHER
                               CHARA

  0130      00
    31      F4
    32      CE DONE            LDX WITH MESS START
    33      01
    34      5A
    35      FF                 STX MESS
    36      A0
    37      4C
    38      BD                 JSR OUTLINE SEZ "NO!"
    39      00

    3A      A0
    3B      39                 RTS    7E
    3C      01                 DF
    3D      01                 0A
    3E      3F                 TEMP STORAGE
```

MISCELLANEOUS

```
  0140}     Write in Chara
  014F}     Ster

  0150      0A
    51      0A
    52      0D
    53      2A
    54      37    *73s
    55      33
    56      27
    57      53
    58      2E
    59      2E

  015A      0A
    5B      0D
    5C      4E    NO!
    5D      4F
    5E      21
    5F      2E

  0160      0A
    61      0D
    62      47
    63      4F    GOOF!
    64      4F
    65      46
    66      21
    67      2E

  0168      0A
    69      0D
    6A      43    CALL?
    6B      41
    6C      4C
    6D      4C
    6E      3F

  0170      0A
    71      0D
    72      46
    73      55    FULL.
    74      4C
    75      4C
    76      2E

  001E}     Starting mem ADR. (0180)
  001F}
```

```
0180        0280
01A0        02A0
01C0        02C0   Etc. Through
01E0        02E0   07E0.........
0200        0300
0220        0320
0240        0340
0260        0360

LOCATIONS WHERE A LINE OF STORAGE
BEGINS
```

LOAD UP (WITH SPACES) ROUTINE

```
  0180      CE
     1      01
     2      93
     3      86
     4      20
  0185      A7
     6      00
     7      8C CPX
     8      01
    09      91
    0A      27
    0B      04
    0C      08 INX
    0D      7E JMP
    0E      01
    0F      85
  0190      3F
  0191}     Last Memory Address to have sp
  0192}
  0193      1st (sp) loaded here & through adr loaded in 0191
```

E, and period, so you can use whatever codes you wish (see 0004, 08 and 0E). Note that 001E contains the starting memory location. Should you decide to store your log info in some other part of memory (maybe the last 4K, or so), you mustn't forget to change this address.

The enter program at 0020 looks for spaces to find an empty spot. You don't need to use spaces; it's just that I liked 'em. You can put just about anything in 0024. Note, too, I went to a little subroutine at A050 in the middle of my program. I added these steps after the entire program was written and wouldn't work. You could put these steps right in the program, or at some other location.

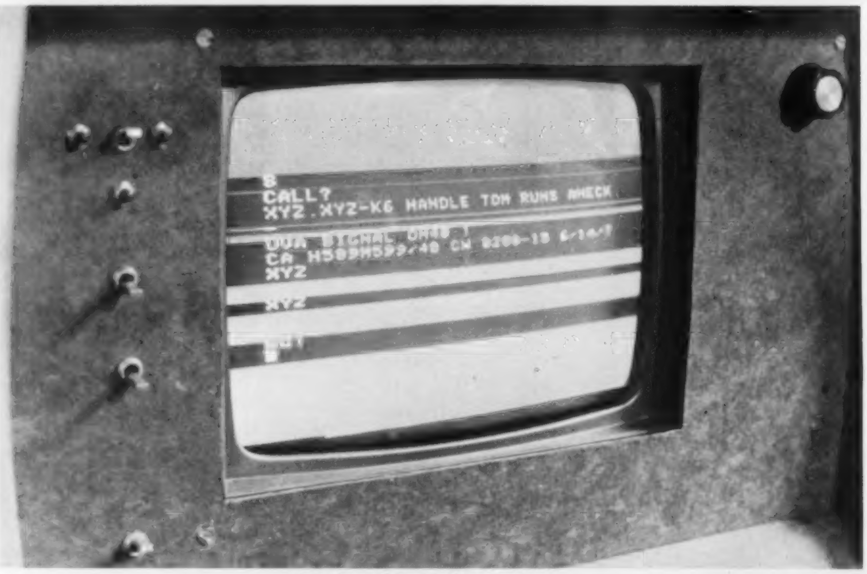
Also, location 0059 loads accumulator B with the most significant bytes of the last memory location you are using (mine was 0FFF until I recently added memory). Don't forget to make 005A fit your system.

Here is an interesting point concerning the EDIT Routine (0075). With this jewel you *have* to change something. That's why you should search to make sure what you want to change is really in the computer, because if the computer says "NO!" in EDIT Routine, it means there are no more lines of data starting with the characters you entered. The problem is that you will then be writing over the message that says

"NO." Don't panic when this happens. Just type "LF/CR/NO!." The period will terminate the edit routine and eliminate this problem. This will probably only happen once; after that you'll learn to search before you change!

The search routine starts at 00CA. It is pretty straightforward. An interesting point is that it has an upper memory limit, too. This is the address of the highest memory position you want to search for. My upper address is 0FFF (add one = 0100). So, the most significant byte 01 is put in the Search Routine at 0028.

Finally, one last point: In the Miscellaneous section, note the memory storage allocations. Temporary data (the three characters you want to search for) are located at 0140 through 014F, and all fixed messages start at 0150. Normally this causes no problems, but if some overzealous person gets to your computer and decides to figure it out alone, he or she may type in over 16 characters instead of the three needed, probably figuring the computer will find it faster that way. Of course when 16 characters are exceeded, the entries will start writing over all your nifty messages. If you find some rather weird messages coming out of your machine, check and see — chances are your friend wrote the Gettysburg Address for you . . . all over your program! ■

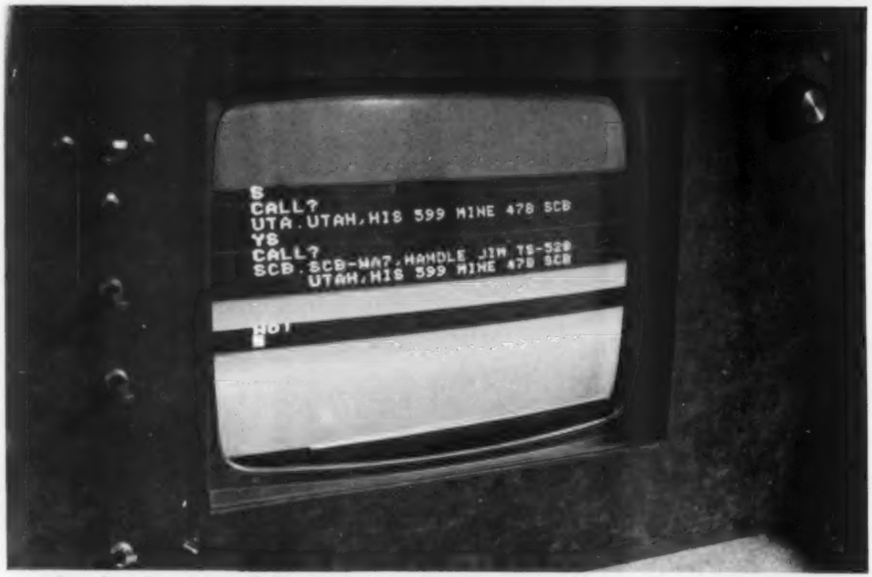


```
S
CALL?
XYZ.XYZ-K6 HANDLE TOM RUNS AHECK
[illegible]
CA H589M599/40 CW 0200-15 6/14/7
XYZ

XYZ

[illegible]
```

Searching for a call in memory.



```
S
CALL?
UTA.UTAH,HIS 599 MINE 478 SCB
YS
CALL?
SCB.SCB-WA7,HANDLE JIM TS-520
    UTAH,HIS 599 MINE 478 SCB

NOT
```

Searching by state, and then retrieving information on a station worked in that state.

EDITORIAL

from page 72

conventions have been drawing the biggest crowds, so we know that a large percentage of hams are definitely interested in computers. The articles in the *73* I/O section reflect this interest and have helped develop it. Computer firms exhibiting at hamfests have been most enthusiastic about the response . . . and the sales of equipment.

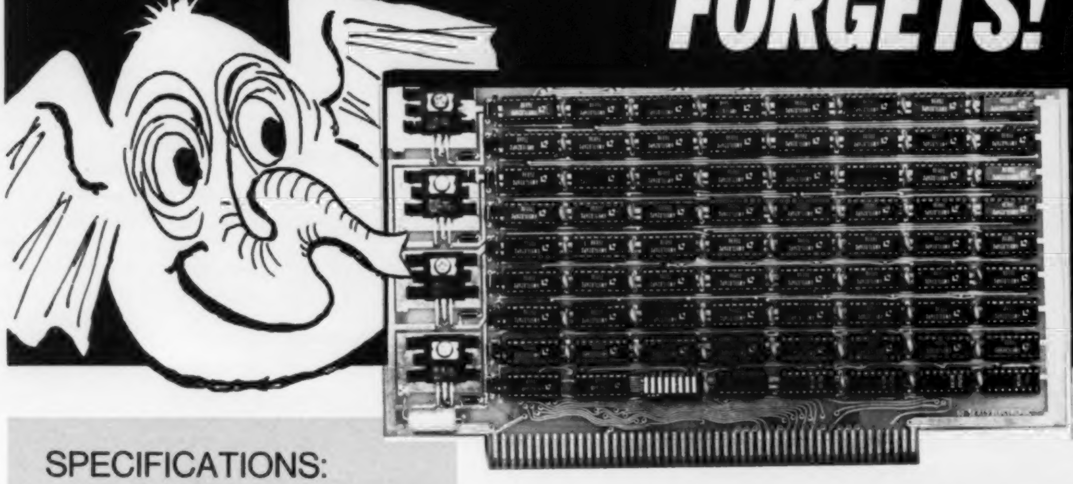
Not as much is known about ham exhibits at computerfests, but there is a marked increase in getting ham licenses by computer hobbyists. They are well aware that a great many of the recent applications for computers have been in ham-oriented applications . . . and they are greatly enthused over the prospects of being able to interface their system with another over the air. You'll see a lot of this happening as more and more repeater systems get geared up for this.

Computerfests and hamfests pull about the same size crowds since there are about as many computer hobbyists as amateurs in the country. But, while amateur radio is growing at about 11%, computerists are growing at about 100% per year . . . it may turn out that a major source of new hams will be via the computer hobby instead of CB. All the more reason to tie hamfests and computerfests together.

If your club is figuring on a hamfest, you could do worse than get our package of information on the hobby computer field . . . it's $50 and you get a list of about 300 hobby computer clubs, over 500 manufacturers and dealers (for prizes and exhibit booth sales), newsletter publishers and magazine editors. You'll also get instructions on how to get PR in this field. The list is on gummed labels, ready to use.

If you have anything big planned, you might call me and see if we can coordinate. I might be able to help set up your speaking program with top computer talent and even help sell a few booths, too. There is only so much of me to go around, so it's got to be good-sized.

The first 8-K that NEVER* FORGETS!



SPECIFICATIONS:

8K SC - 8 Specifications:

Access Time:	500 ns Max. (225 max on request)
Current Req:	Less than 200 ma per 1024 words maximum
Memory Chip:	AMD 91L02 APC **(low** power 1K x 1)
Voltage Supply:	+5 to +10 volts
Battery Standby:	1.5 to 2 Volt, Automatic power loss sensing circuit. Eliminates need for switches.
Address Select:	8 ea. Spst. switches in a Dip IC package (No longer any need for a soldering iron to change address.)
+5 Volt regulated:	4 ea. 7805 regulators with individual heat sinks to run cooler.
Wait States:	NONE! Your wait light will not burn because of a memory wait state.

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Circuit Board

Double sided, G10 glass epoxy board
Plated through holes. 5 mil. tin minimum
Solder reflow processed
Solder mask on both sides of PC board
Component lay out silk screened on component side of PC board
Gold plated edge contacts
No jumper wires used
Professional layout techniques used

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•

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Short On Memory?

- - build this 2K board for your 6800

John W. Molnar WB2ZCF
Box 561
Ridgefield NJ 07657

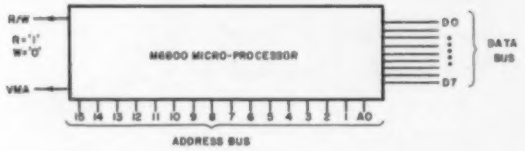


Fig. 1. M6800 control lines used by the memory interface. Read/write line (R/W) controls flow of data on 8 bit bidirectional data bus. The valid memory address line (VMA), when HI, allows the interface to respond to the 16 bit address on the address bus. Each address line, when HI, represents a power of two in the binary numbering system. For example, if lines A0, A2, and A10 are HI, the address sent to the interface is equal to $(2^0 = 1 + 2^2 = 4 + 2^{10} = 1024)$ *or* 1029_{10}.

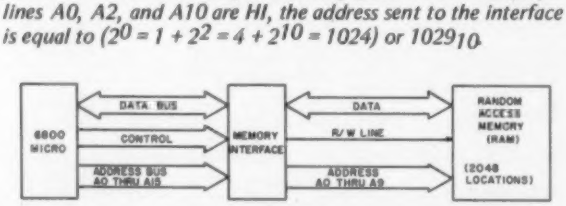


Fig. 2. Information flow between micro, interface and memory. Note that only address lines A0-A9 go to memory, as the interface uses remaining lines to decode valid memory addresses.

Medical science tells us that only a tiny fraction of the human brain's capacity is used during an individual's lifetime. This excess memory capacity is unfortunately not a feature of the average home microcomputer system, a fact which usually causes the experimenter to seek additional "brain power" almost as soon as the new micro kit or prototype is finished and running. Most of the commercially supplied micro kits provide only minimum memory, usually 1024 bytes (1K) or less. It is in this memory that the user's application programs and language processors (such as BASIC) must reside.

A typical amateur radio application for a microprocessor system is the control of a RTTY station. The micro can be programmed to send CQs, answer calls automatically, detect speed changes, etc. However, it becomes immediately obvious to the operator of the station that more memory than is supplied with most micro kits is required to handle even the simplest functions, such as sending a list of station equipment. For example, the single message:

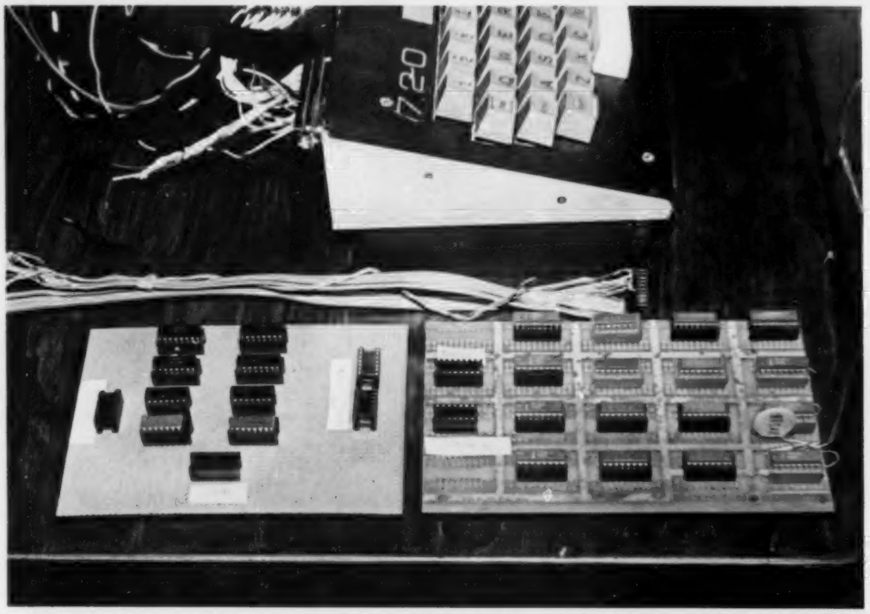
CQ CQ FROM WB2ZCF – "JOHN"

takes about 33 characters, including shift functions. Taking into account that the machine code to control the system occupies the same memory, it becomes obvious that, when stored in memory, even a short list of equipment, when added to other operator comments, rapidly eats up critical space. Think about some of those other functions that can be controlled by a micro, and you will be ready to consider adding memory capacity to your micro system. There are two ways of making your micro smarter – buying a commercial 2K or 4K board and sliding it into your system or, in the best ham tradition, home brewing a memory system for your setup.

This article describes the latter approach – a complete do-it-yourself 2K memory system for a Motorola 6800 type microprocessor, including interface and memory board. The design uses popular (and inexpensive) 2102 static memory chips, and the interface design may be modified to support other microprocessors. All parts used in this project are readily available from *73* advertisers.[1] I have attempted to present in logical order the background required to understand the project, the design criteria, pitfalls, actual construction and logic analysis, and, finally, the debug techniques used in bringing up the add-on memory. Hopefully, this will encourage those of you who need additional memory for your systems to consider building it yourselves.

The Background – or, the Microprocessor's Nervous System

The Motorola M6800 microprocessor is capable of



Completed memory interface (left) and 2K memory board (right) using 16 type 2102-1 RAM chips. Note ribbon cable (rear) used in system interconnection. The interface is constructed on perfboard, using wire-wrapped connections. The memory is built on a scrap piece of PC board with etched power leads.

supporting up to 65,536* bytes of random access memory. The single byte accessed during a machine cycle is selected by 16 address lines. Each address line may be viewed as a digit (1 or 0) in the binary system; therefore, the unique memory address generated by the micro is really a binary number in the range of 0-65,535 (see Fig. 1). The data to be read or written by the micro is transferred over eight data lines, or the data bus. The memory is directed to read or write by a single line, the R/W line. If the 6800 places a 1 (TTL HI) on the R/W line, the memory sends the single byte of data (whose address was presented on the 16 line address bus) to the micro over the data bus. A 0 on the R/W line causes a memory write to occur; the data on the data bus is written into memory. One control line, called VMA (Valid Memory Address), is a 1 if the micro really wants to access memory. These lines, the address, data bus, R/W, and VMA, must be used to coordinate data flow between the micro and our planned add-on memory. The logic required to do this is called an *interface*. We will build a simple interface to control our new memory (see Fig. 2). Since all micros do not have a VMA line or its equivalent, the design of the interface includes a method of removing the VMA function.

Interface Design — Controlling the Data Flow

The interface has three primary functions. The first and most important function is to determine that the address on the address bus is really intended for our memory. You may wonder how an address could possibly be invalid — until you realize that when adding a 2K memory to a system capable of addressing 65K, some means must be employed to "channel" addresses to the area where memory really exists. This process is called address decode and is a concept common to any memory design. There are address decoding techniques that could make our 2K add-on respond to any 2K range of addresses within the allowable 65K, but for simplicity we will place our memory in the range of 0-2047. The actual process of address decode is simple in practice, requiring only a couple of packages in my design.

Recalling that the data bus in the 6800 is bidirectional, we need some method of making the memory correctly receive and transmit data over a common bus when commanded by the R/W line. This, the second feature of the interface, is accomplished by using *three-state* logic. This logic has the familiar 1 and 0 TTL output levels, as well as an "open circuit" state. Thus, upon command, a gate with three-state output capability may appear to be an open circuit to any other device on the same line. This allows us to parallel (OR-TIE) many gates to the same bus, with only one actually driving the bus at a given time. The design presented here uses three-state logic to drive the data bus. On a memory read cycle, the gates driving the bus are turned on (or enabled) by the R/W line, allowing memory data to flow from the 2102s to the microprocessor. On a write cycle, the gates previously enabled are driven into the open circuit mode, allowing data to flow into the memory (see Fig. 3). The final function of the interface is to buffer the address, data, and control lines. Most MOS microprocessors such as the 6800 can drive only one TTL load per line; thus it is most important not to overload the micro. The interface uses 7400 gates between all micro lines and interface logic. Using the NAND gate as a buffer causes the signal to be inverted, a useful characteristic in some parts of the interface.

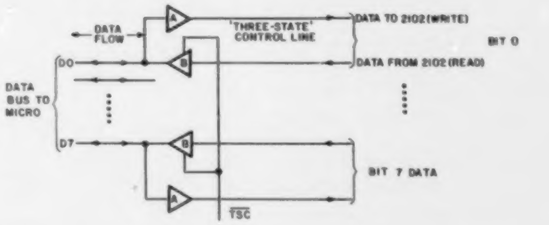


Fig. 3. Three-state logic allows devices to be paralleled on the bidirectional data bus. During a memory write cycle, the TSC line is HI, allowing data to pass from the data bus through device A into memory. The B devices are forced into an open circuit condition, thus not affecting data flow. On a read cycle, a LO on the TSC line turns on device B, allowing data passage from memory to the data bus. Device A, although always enabled, is not affected by read data passing through it, as the 2102 memory's write line is off during a read cycle.

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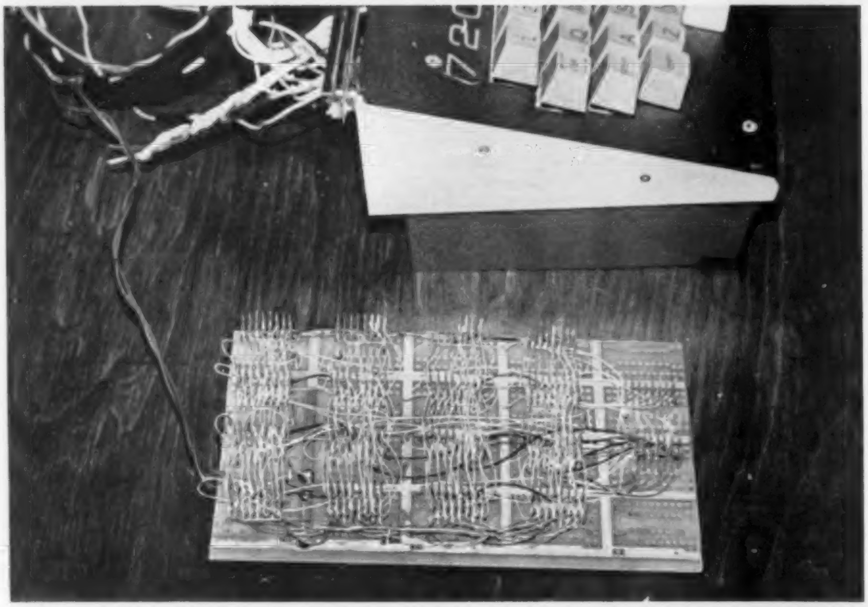
*All numbers are base 10 unless otherwise indicated.



Underside of the 2K memory showing wire-wrap construction. The four distinct "waves" of wire-wrap indicate the number of parallel connections between memory chips. Refer to Fig. 5 for memory schematic.

Some Pitfalls – Be Ye Wary!

One desirable feature of the M6800 microprocessor system can be a possible problem when adding memory. Input and output operations, as well as some system features, use actual memory addresses to initiate and control special functions. For example, micro systems using the MIKBUG® monitor program (such as the SWTP 6800) use locations from $A000_{16}$ – $A07F_{16}$ for system storage, and some locations around 8000_{16} are used for I/O control. These locations must not be overlapped by add-on memory. My system also restricts the use of the upper few memory locations, as they are reserved for system use in a special Read-Only Memory. The point of all this is to be careful where add-on memory is located using address decode techniques. Overlapping system locations can and will cause difficult debugging sessions once the system is running.

Good digital construction practices must be used when working with memory systems. No "software" problem is harder to find than one caused by a hardware glitch. Noise is a problem in systems with add-on memories, as the new memory is seldom on the same board as the original. Liberal doses of power supply bypassing are a must – I used 0.2 uF capacitors in parallel with 0.01 uF ones to bypass power leads. The interface and memory boards are wire-wrapped, but all IC power connections are soldered to the wire-wrap stakes, using #18 bus wire. Interconnection lead length is not critical; mine are 9" between microprocessor and interface and about the same between memory and interface.

The Interface – Linking Micro and Memory

The interface is represented in Fig. 4. All connections between the micro, memory, and interface are made using standard 14 and 16 pin wire-wrap sockets. The cables are ribbon cable with IC header connectors used as plugs. The interface functions as follows: Address decode is accomplished in part by keying on the A10 address line to determine if the address is in the range of $0\text{-}1023_{10}$ (Bank 0) or 1024-2047 (Bank 1). Line A10 allows us to select the bank to be accessed, as described below. The 2102 type RAM is formatted 1024 bits by one bit wide; thus it takes eight RAMs, each contributing a single bit, to make up one memory bank consisting of 1024 bytes (8 bits to a byte). It takes 10 address lines to resolve an address in the range of 1024 bytes; therefore, lines A0-A9 are connected to each 2102. A given bank of eight RAMs is enabled or selected by bringing the enable pin (pin 13) low. The eight enable lines of each bank are in parallel to select eight RAMs at once. Since our memory is to respond only to addresses in the range of $0\text{-}2047_{10}$, all other addresses must be "locked out" by our address decode logic, which works as follows: Any address outside the allowable range will have one address line between A11 and A15 activated. IC1 and IC2A invert and buffer the incoming address lines and pass the resulting five signals to IC3, a 7430 eight-input NAND gate. This gate produces a TTL HI output if any of the eight input lines goes LO, a condition caused by one of the inverted address lines containing an invalid (HI) address. If all five of the address lines in question are LO, the output of the 7430 is LO; this signal, called $\overline{\text{ENAB}}$ (ENABLE), will allow the

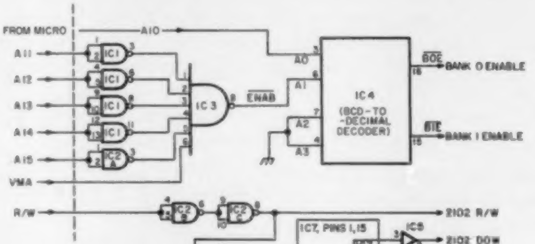

FROM MICRO
A10
A11
A12
A13
A14
A15
VMA
R/W
IC1
IC2 A
IC3
$\overline{\text{ENAB}}$
A0
A1
A2
A3
IC4 (BCD-TO -DECIMAL DECODER)
$\overline{\text{B0E}}$ BANK 0 ENABLE
$\overline{\text{B1E}}$ BANK 1 ENABLE
IC2 B
IC2 C
IC2 D
2102 R/W
IC7, PINS 1,15
IC5
IC6
IC7
IC8
D0
D1
D2
D3
D4
D5
D6
D7
2102 D0W
2102 D0R
D1W
D1R
D2W
D2R
D3W
D3R
D4W
D4R
D5W
D5R
D6W
D6R
D7W
D7R
MICRO DATA BUS
IC8, PINS, 1, 15
IC1, IC2 – 7400 PIN 7 - GND 14 - +5
IC3 – 7430 PIN 7 - GND PIN 11,12, 14 - +5
IC5, IC6 – FAIRCHILD 34050 PIN 8 - GND 1 - +5
IC7, IC8 – FAIRCHILD 340097 PIN 8 - GND 16 - +5
IC4 – 7441 PIN 12,7,4 GND 5 - +5

Fig. 4. Memory interface schematic.

memory bank selected to respond to the memory access. Note that the VMA line is also connected to IC3. Recall that VMA is HI if the micro really wants a memory access. A LO on VMA disables the memory exactly as an invalid memory address would.

If your micro does not have a VMA line, tie IC3, pin 6, to Vcc along with pins 11 and 12 (the unused inputs). The above process satisfies the address decode function described earlier. Now, recall that our 2K memory is actually two banks of 1K, each bank having an enable line formed by interconnecting the 2102 enable lines. We must now select the bank desired, as well as using the $\overline{\text{ENAB}}$ signal formed by the decode process. The key to bank selection is based on the fact that line A10 is LO when addresses 0-1023 are referenced, and HI when addresses 1024-2047 are referenced. This fact allows the easy selection of Bank 0 or Bank 1, if the $\overline{\text{ENAB}}$ signal is active. IC4 is a "data decoder" chip, which provides a unique LO output based upon four input signals. For example, if input lines I0-I3 contain data "LO LO LO LO," the first of ten output lines will be LO. If the input data is "HI LO LO LO," the second output line will be LO; the first returns to a HI state. The remaining input-output correspondence is not used in this design. Since we only desire to monitor one input line (A10), we connect it to IC4 pin 3. Then, when A10 goes LO, IC4 pin 16 goes LO, thus enabling Bank 0. If A10 goes HI, IC4 pin 15 goes LO, selecting Bank 1. Our $\overline{\text{ENAB}}$ signal is fed to the second IC4 input, pin 6. If $\overline{\text{ENAB}}$ goes HI (invalid address), both of the outputs that enable our banks go HI, effectively disabling the entire memory system. It may be seen that the unused inputs and outputs of the data selector IC4 could be used in more elaborate memory systems. (Refer to the *Fairchild TTL Data Book* for a detailed explanation of the 7441 data selector.)

So far we have determined that the address presented to the interface is valid and the correct bank has been selected. All that remains is to control the 2102 read/write function as well as the three-state data bus drivers. The R/W signal is buffered and inverted by IC2B. This output is re-inverted by IC2C and fed to the 2102 read/write lines to direct data flow within the memory chips. This signal is inverted and used to drive the three-state control lines of IC7 and IC8, the data bus drivers. The additional inversion is required as an active LO signal enables the bus drivers, while a HI signal causes the 2102 chips to output data (read cycle). Finally, note that each 2102 receives address lines A0-A9, as described earlier. The interface board was wire-wrapped on a standard perfboard (see photo). The memory and interface could have been constructed on a single board, eliminating some interconnections, but I chose to make the interface separate as I had a 2K memory board left over from a former project. The choice is left to the reader.

The Memory — Lots of Bytes For a Few Bucks

The 2102 RAM device is an economical choice for memory systems under 8K. Eight of the chips are required for each 1K byte of memory. When constructing a memory board, for each 1K bank, tie address lines A0-A9, the $\overline{\text{CE}}$ lines, the R/W lines, and the DATA IN, DATA OUT lines to form five memory buses. As banks are formed, all buses are tied *except* the $\overline{\text{CE}}$ bus, which is used to select banks. Refer to Fig. 5 for details. The memory may be constructed on perfboard and wire-wrapped, but be sure to provide heavy power lines, as described earlier. Commercial memory boards may be used with the home brew interface if the builder so desires.[2] If this approach is taken, be sure that no address decoding is done on the commercial board, or an address conflict will occur.

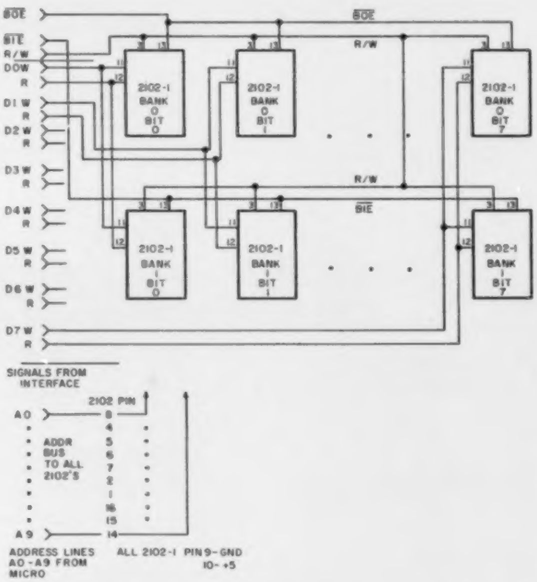


Fig. 5. 2K memory consisting of two banks of 1K each. Note that the A0-A9 address bus goes to all 16 2102-1 RAMs, as does the R/W line. The eight enable pins of Bank 0 tied to B0E from the interface (pin 13). All enable lines from Bank 1 go to B1E. Finally, the D0W and D0R lines go to pins 11 and 12 respectively on Bank 0, bit 0, and Bank 1, bit 0. This pattern of interconnections follows for the remaining D-W, R pairs.

And Finally — Testing

Once the interface has been developed and a memory constructed, the system may be connected to the microprocessor board. Connect all buses as indicated in Fig. 6. Five volt power (Vcc) for the interface can probably be borrowed from the micro, as the drain is under 60 mA. However, 2K of 2102 RAM requires upwards of 700 mA, dictating a separate supply unless the main supply has the beef. Remember to tie all ground leads if using more than one 5 V source. In some cases it is necessary to remove existing memory chips from the micro board if they conflict with the add-on memory. For example, my Motorola MEK prototype board had several 128 byte RAMs in low memory that would have conflicted, so I popped them out and used them in another system.

After making all interconnections and checking for obvious shorts, etc., apply power and check for smoke — aargh! If all looks good, insert the ICs, reapply power, and then attempt to read a new location. Many 6800 systems use the Motorola MIKBUG® monitor, which enables the user to execute an "M" command to examine memory. A random pattern should be present. Now attempt to rewrite the location, checking for correct data. Systems with front panel switches, such as the MITS 680, can be checked by manually reading/writing new locations. Next, check the location following the last one supported by the add-on (2048 in this system). It should be zero, indicating

The "Big Three" Motorola MEK 6800 microprocessor evaluation board (left) provides computing power for RTTY system. The memory interface and memory board providing add-on memory capability are alongside. The converted television set in the background provides temporary display capability, while using a Model 19 (not shown) for hard copy. The Sanders 720 ASCII terminal may also be used "on-line" with software ASCII/Baudot conversion.

correct address decode. Also, try locations that are 2K multiples of the add-on, such as 4096, etc. They, too, should be zero. If all is OK so far, load and execute a program — better yet, write that new application! Don't get lost in all that new memory.

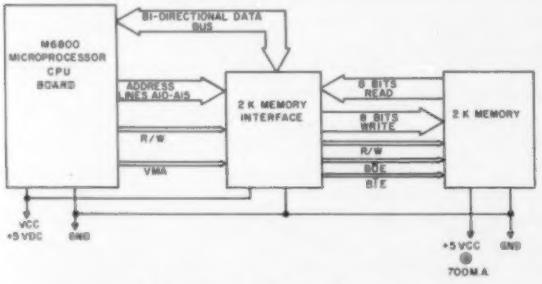


Fig. 6. System interconnections.

In Case of Problems — Don't Break the Board

The most likely problem area is in the address decode logic. If locations read/write erratically, check for address overlap with existing memory or I/O devices. If two devices answer an access request, an error is sure to result. Look for *patterns* in errors — if a single bit of multiple bytes is set or off continuously, check for memory board data line wiring errors. Repetitive errors are easy to isolate due to the fact that so many elements are tied together. Don't discount the possibility of a bad 2102. They are MOS devices, capable of being zapped by static charges during installation. Handle them with care. DO NOT attempt to use old 2102 devices without the "-1" suffix. These are 1000 ns devices and much too slow to be used with 6800 and 8080 systems, especially considering the propagation delays introduced by the interface. Use 2102-1 (500 ns) devices, available from several *73* advertisers.[1]

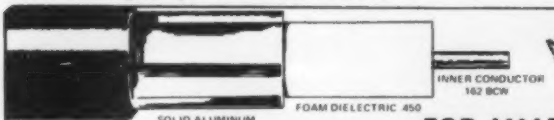
And Finally . . .

After adding a couple of K to your system, applications should suggest themselves at every turn. In order to run BASIC or other language processors, at least 8K will be required. Hopefully, having built the simple 2K system, you will be encouraged to tackle a larger memory system using some of the suggested techniques. A future article will discuss the use of dynamic RAM devices in large memory systems, should you exhaust your 2102 space. Until then, however, *good luck* and *good programming.* ■

References

[1] Bill Godbout Electronics, Box 2355, Oakland Airport CA 94614. James, 1021 Howard Ave., San Carlos CA 94070.

[2] Dutronics, Box 9160, Stockton CA 95208. Morrow's Micro-Stuff, Box 6194, Albany CA 94706.



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SPECIFICATIONS

CPU

MC 6800; eight-level interrupt, prioritized and maskable by level; single-cycle and block DMA

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Complete paper tape replacement; start/stop motor control; 300, 600, or 1200 baud (crystal controlled); error correction

VIDEO TERMINAL INTERFACE

64 x 32 lines
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MEMORY

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KEYBOARD

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A Software Replacement for the Muffin Fan

- - IC cooling program

One of the most fundamental and oft-forgotten principles of electronic tinkering is that of semiconductor heat generation. Whether that tinkering involves a new design, or modification of an existing design, heat calculations are usually a must. I've presented here a simple and straightforward method of heat calculations, designed to take the "black magic" aura away. Also included, for the individual with access to a computer, is a lazy man's program (called Pele) which performs all the calculations with ease.

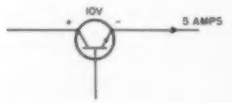


Fig. 1. 2NXXX pass transistor dissipating 5 Watts of power.

For this discussion, I will consider only transistors in the examples given. Obviously, the same method can be applied to diodes and ICs and, in fact, the last example using the Pele program was based on a voltage regulator IC. It should also be pointed out that this is only one method of calculating heat generation and there are other equally good procedures.

The first question I usually have regarding a semiconductor is, "How much power can I pour into the little devil without blowing its brains out?" If I were not wise in the ways of the world, I might take the following approach (for a dc application): look up the maximum current and voltage ratings, and let it go at that. For example: I am planning to use a 2NXXX as a pass transistor in a power supply. The maximum ratings (taken from an actual data sheet) are 70 volts maximum collector to emitter voltage and .7 Amps maximum collector current (I_C). Since I am conservative by nature, I plan to drop only 10 volts across the pass element and pull .5 Amps through it. Therefore, I am dissipating 5 Watts in the device, in the form of heat. This might seem reasonable, since the device is advertised as a 5 Watt transistor. Do I really know what I am doing? Let's see. Fig. 1 indicates the situation we are about to analyze.

Analysis Procedure

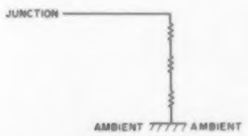
Step 1. Draw a thermal resistance sketch of the device and its surroundings. Assume a heat sink will be used. Each thermal resistance (Θ) can be indicated by the symbol for a resistor. See Fig. 2.

Step 2. Next add to the diagram the following (from data sheet):

Θ_{JA} – the junction to air thermal resistance (°C/W).

Θ_{JC} – the junction to case

Fig. 2. Step 1: Thermal resistance sketch.


JUNCTION
AMBIENT
AMBIENT

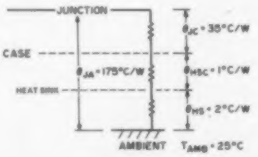

JUNCTION
CASE
HEAT SINK
θ_{JA} = 175°C/W
θ_{JC} = 35°C/W
θ_{HSC} = 1°C/W
θ_{HS} = 2°C/W
AMBIENT
T_{AMB} = 25°C

Fig. 3. Step 2: Thermal resistance sketch.

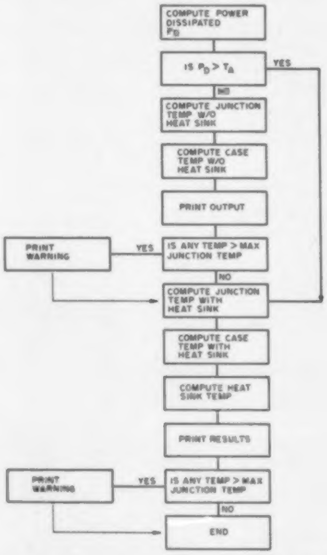

COMPUTE POWER DISSIPATED P_D
IS $P_D > T_A$
YES
NO
COMPUTE JUNCTION TEMP W/O HEAT SINK
COMPUTE CASE TEMP W/O HEAT SINK
PRINT OUTPUT
IS ANY TEMP > MAX JUNCTION TEMP
YES
PRINT WARNING
NO
COMPUTE JUNCTION TEMP WITH HEAT SINK
COMPUTE CASE TEMP WITH HEAT SINK
COMPUTE HEAT SINK TEMP
PRINT RESULTS
IS ANY TEMP > MAX JUNCTION TEMP
YES
PRINT WARNING
NO
END

Fig. 4. Flowchart used to generate Pele.

```
PELE

     SEMICONDUCTOR   HEAT   DISSIPATION   PROGRAM

IF SERIAL DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 1
IF IMMED. DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 2
IF DIRECT DATA ENTRY (NO QUESTIONS) IS DESIRED, TYPE 3
? 1


WHAT IS THE MINIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE
SUBJECTED TO , IN DEGREES C
? -3
WHAT IS THE MAXIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE
SUBJECTED TO, IN DEGREES C
? 101.2
WHAT IS THE MAXIMUM ALLOWABLE JUNCTION TEMERATURE,IN
DEGREES C —— IF UNKNOWN, TYPE 200
? 200
WHAT IS THE MAXIMUM ALLOWABLE POWER DISSIPATION,IN WATTS AT
25 DEGREES C, AMBIENT
? 2.4
WHAT IS THE JUNCTION TO AIR THERMAL RESISTANCE,IN DEGREES C
PER WATT
? 62
WHAT IS THE JUNCTION TO CASE THERMAL RESISTANCE,IN DEGREES C
PER WATT
? 17
WHAT IS THE THERMAL RESISTANCE OF THE SIL PAD
OR HEAT SINK COMPOUND,IN DEGREES C —— IF UNKNOWN , TYPE 1
? 1
WHAT IS THE THERMAL RESISTANCE OF THE HEAT SINK,IN DEGREES C
PER WATT
? 10
WHAT IS THE VOLTAGE DROP (WORST CASE) ACROSS THE DEVICE,
IN VOLTS
? 20
WHAT IS THE CURRENT (WORST CASE) THROUGH THE DEVICE,IN AMPS

? .1


DEVICE CAN BE USED WITHOUT HEAT SINK


          DEVICE TEMPERATJRES WITHOUT  A HEAT SINK

AMBIENT TEMP.       -3.0 C              25.0 C              101.2 C

JUNCTION TEMP.     121.0 C             149.0 C              225.2 C
CASE TEMP.          87.0 C             115.0 C              191.2 C

**WARNING**MAX. JUNCTION TEMP. EXCEEDED—WILL DESTRUCT
THIS MUST BE A LOUSY DESIGN

          DEVICE TEMPERATURES WITH A HEAT SINK

AMBIENT TEMP.       -3.0 C              25.0 C              101.2 C

JUNCTION TEMP.      53.0 C              81.0 C              157.2 C
CASE TEMP.          19.0 C              47.0 C              123.2 C
HEAT SINK TEMP.     17.0 C              45.0 C              121.2 C

PROCESSING     1 UNITS
```

Fig. 5. Actual problem using Pele.

thermal resistance (°C/W).

Θ_{HSC} — the heat sink compound (or silicon washer) thermal resistance (°C/W); if unknown, specify 1°.

Θ_{HS} — the heat sink thermal resistance (°C/W); mnemonic of Θ_{SA} also used instead of Θ_{HS}.

T_{AMB} — the ambient temperature (°C).

Note that with the exception of the last parameter all units are the same, i.e., degrees C per Watt (°C/W). This is the standard unit of thermal resistance. See Fig. 3.

Step 3. Multiply the total power dissipated (in Watts) in the device by Θ_{JA}. This will tell us how hot the junction will become (*above* ambient) without a heat sink. For our example, $P_D \times \Theta_{JA}$ = 5 W x 175°C/Watt = 875°C above ambient = 900°C. That is pretty warm, and it looks like I *didn't* know what I was doing; the maximum junction temperature as listed on the data sheet is 200°C. What happened to the 5 W advertisement? If I had read the fine print, I would have noticed that this 5 W rating applied only at case temperature (T_C) up to 25°C. If I

```
PELE

35 PRINT '     SEMICONDUCTOR   HEAT   DISSIPATION   PROGRAM'
36 PRINT
37 PRINT
40 PRINT 'IF SERIAL DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 1'
41 PRINT 'IF IMMED. DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 2'
42 PRINT 'IF DIRECT DATA ENTRY (NO QUESTIONS) IS DESIRED, TYPE 3'
43 INPUT Z
44 IF Z=3 GO TO 197
53 PRINT
54 PRINT
100 PRINT 'WHAT IS THE MINIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE'
101 PRINT 'SUBJECTED TO , IN DEGREES C'
102 IF Z=2 GO TO 115
110 INPUT A
115 PRINT 'WHAT IS THE MAXIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE'
116 PRINT 'SUBJECTED TO, IN DEGREES C'
117 IF Z=2 GO TO 125
120 INPUT B
125 PRINT 'WHAT IS THE MAXIMUM ALLOWABLE JUNCTION TEMERATURE,IN'
126 PRINT 'DEGREES C —— IF UNKNOWN, TYPE 200'
127 IF Z=2 GO TO 130
128 INPUT C
130 PRINT 'WHAT IS THE MAXIMUM ALLOWABLE POWER DISSIPATION,IN WATTS AT'
131 PRINT '25 DEGREES C, AMBIENT'
132 IF Z=2 GO TO 140
135 INPUT D
140 PRINT 'WHAT IS THE JUNCTION TO AIR THERMAL RESISTANCE,IN DEGREES C'
141 PRINT 'PER WATT'
142 IF Z=2 GO TO 150
145 INPUT E
150 PRINT 'WHAT IS THE JUNCTION TO CASE THERMAL RESISTANCE,IN DEGREES C'
151 PRINT 'PER WATT'
152 IF Z=2 GO TO 160
155 INPUT F
160 PRINT 'WHAT IS THE THERMAL RESISTANCE OF THE SIL PAD'
161 PRINT 'OR HEAT SINK COMPOUND,IN DEGREES C —— IF UNKNOWN , TYPE 1'
162 IF Z=2 GO TO 170
165 INPUT G
170 PRINT 'WHAT IS THE THERMAL RESISTANCE OF THE HEAT SINK,IN DEGREES C'
171 PRINT 'PER WATT'
172 IF Z=2 GO TO 180
175 INPUT H
180 PRINT 'WHAT IS THE VOLTAGE DROP (WORST CASE) ACROSS THE DEVICE,'
181 PRINT  'IN VOLTS'
182 IF Z=2 GO TO 190
185 INPUT J
190 PRINT 'WHAT IS THE CURRENT (WORST CASE) THROUGH THE DEVICE,IN AMPS'
191 PRINT
192 IF Z=2 GO TO 196
195 INPUT K
196 IF Z=1 GO TO 200
197 INPUT A,B,C,D,E,F,G,H,J,K
198 REM  COMPUTE THE POWER DISSIPATED— MULTIPLY J*K
200 X=J*K
209 REM  IF POWER DISSIPATED IS GREATER THAN D , HEAT SINK IS NECESSARY
210 IF X>D GO TO 500
212 REM  COMPUTE THE FREE AIR JUNCTION TEMPERATURES AT THE 3
213 REM  DIFFERANT TEMPERATURES
220 J1=(E*X)+A
230 J2=(E*X)+25
240 J3=(E*X)+B
245 REM COMPUTE FREE AIR CASE TEMPERATURES
250 C1=J1-(F*X)
260 C2=J2-(F*X)
270 C3=J3-(F*X)
277 PRINT
278 PRINT
279 PRINT
280 PRINT 'DEVICE CAN BE USED WITHOUT HEAT SINK'
290 PRINT
300 PRINT
304 PRINT
310 PRINT '         DEVICE TEMPERATURES WITHOUT  A HEAT SINK'
313 PRINT
314 PRINT
315 PRINT USING 316 A,B
316 :AMBIENT TEMP.       ###.# C             25.0 C              ###.# C
317 PRINT
320 PRINT USING 330 J1,J2,J3
330 :JUNCTION TEMP.      ###.# C             ###.# C             ###.# C
340 PRINT USING 350 C1,C2,C3
350 :CASE TEMP.          ###.# C             ###.# C             ###.# C
351 REM  TEST FOR EXCEEDED JUNCTION TEMPERATURE AT 3 TEMPS
352 IF J1>C GO TO 440
353 IF J2>C GO TO 440
354 IF J3>C GO TO 440
355 GO TO 500
440 PRINT
441 PRINT '**WARNING**MAX. JUNCTION TEMP. EXCEEDED—WILL DESTRUCT'
442 PRINT 'THIS MUST BE A LOUSY DESIGN'
445 REM COMPUTE JUNCTION TEMPERATURES WITH A HEAT SINK AT THE 3 TEMPERAT
URES
500 J4=(F+G+H)*X+A
510 J5=(F+G+H)*X+25
520 J6=(F+G+H)*X+B
525 REM COMPUTE CASE TEMPS. WITH A HEAT SINK AT THE 3 TEMPERATURES
530 C4=J4-(F*X)
540 C5=J5-(F*X)
550 C6=J6-(F*X)
555 REM COMPUTE HEAT SINK TEMPERATURES AT THE 3 VARIOUS TEMPERATURES
560 H1=C4-(G*X)
570 H2=C5-(G*X)
580 H3=C6-(G*X)
590 PRINT
591 PRINT
595 PRINT '         DEVICE TEMPERATURES WITH A HEAT SINK'
596 PRINT
597 PRINT
598 PRINT USING 599 A,B
599 :AMBIENT TEMP.       ###.# C             25.0 C              ###.# C
600 PRINT
601 PRINT USING 610 J4,J5,J6
610 :JUNCTION TEMP.      ###.# C             ###.# C             ###.# C
620 PRINT USING 630 C4,C5,C6
630 :CASE TEMP.          ###.# C             ###.# C             ###.# C
640 PRINT USING 650 H1,H2,H3
650 :HEAT SINK TEMP.     ###.# C             ###.# C             ###.# C
651 REM TEST FOR EXCEEDED JUNCTION TEMP. AT THE 3 TEMPS.
652 IF J4>C GO TO 680
653 IF J5>C GO TO 680
654 IF J6>C GO TO 680
655 GO TO 700
680 PRINT
681 PRINT '**WARNING**MAX. JUNCTION TEMP. EXCEEDED—WILL DESTRUCT'
682 PRINT 'THIS MUST BE A LOUSY DESIGN'
700 END
```

Fig. 6. The Pele program.

cooled the case with an infinite heat sink, like liquid nitrogen, I might get away with it.

Step 4. To find the case temperature without a heat sink, subtract the quantity ($P_D \times \Theta_{JC}$) from the previously calculated junction temperature. For our example:

$$\text{Case Temp.} = 900°\text{C} - (P_D \times \Theta_{JC}) = 900°\text{C} - (5\ \text{W} \times 35°\text{C/W}) = 900°\text{C} - 175°\text{C} = 725°\text{C}$$

So now we have found that without using a heat sink, 5 Watts of power will heat up the junction of the transistor to 900°C and the case to 725°C. In other words, that 2NXXX will be vaporized!

Calculations with a Heat Sink

Step 5. How much will a heat sink help? To find out, add up the individual thermal resistances on the right side of Fig. 3 ($\Theta_{JC} + \Theta_{HSC} + \Theta_{HS}$) and then multiply by P_D. In our case: 5 W x 38°C/W = 190°C above ambient = 215°C junction temperature. This is a lot closer, but still above the specification for maximum junction temperature.

Step 6. Find the case temperature in much the same way as before. Subtract the quantity ($P_D \times \Theta_{JC}$) from the junction temperature:

$$\text{Case Temp.} = 215°\text{C} - 175°\text{C} = 40°\text{C}$$

Step 7. Calculate the temperature of the heat sink by subtracting the quantity ($P_D \times \Theta_{HSC}$) from the case temperature.

$$\text{Heat Sink Temp.} = 40 - (5\ \text{W} \times 1°\text{C/W}) = 35°\text{C}$$

This is an interesting fact, because it shows that while the heat sink is relatively cool (35°C), the junction is very hot. (Remember that the next time you think your calibrated fingertip is telling you something about how hot a device is getting.)

Step 8. Relax. In my case I shall ponder the acquisition of a new device. Let's summarize:

2NXXX Transistor
(dissipating 5 W)

	25°C Ambient
Without Heat Sink	
Junction Temp.	900°C
Case Temp.	725°C
With Heat Sink	
Junction Temp.	215°C
Case Temp.	40°C
Heat Sink Temp.	35°C

For this example, a 25°C ambient was assumed. Naturally the highest operating ambient should be chosen for this value.

Sometimes a specification is given for power dissipation at 25°C with no heat sink. In this case (T_a), the free air dissipation was 1 Watt (this would have told me right away I could not use the device at all without a heat sink, because I was dissipating 5 W).

A flowchart of the foregoing method is given in Fig. 4. This flowchart was also used to generate a program in BASIC on a 370 computer.

The Program

The Pele program can input data in any one of three ways: (1) after each text question; (2) after all the text questions; or (3) directly, without text questions. Pele then calculates the junction and case temperatures without a heat sink and also the junction, case and heat sink temperatures when a heat sink is used. It does both of these at three different ambient temperatures with 25°C ambient as the center line value. If the power dissipated at 25°C (P_D) exceeds T_a, Pele will only print out the "with heat sink" temperatures. If the junction temperatures exceed the maximum inputted value, Pele will print out a caustic remark. An actual problem which was run using Pele is shown in Fig. 5. The Pele program is listed in Fig. 6.

Finally, why name a program after a soccer player? Didn't you know? Pele is the Hawaiian God of Fire. ■

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(1000 mA range: ±0.5% F.S. ±1.8% of reading)
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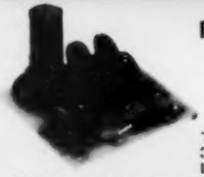

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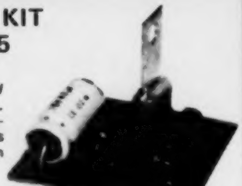

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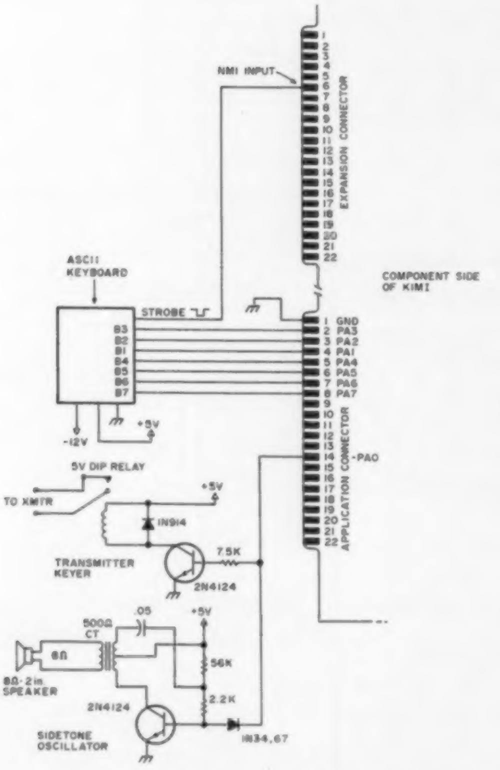
NMI INPUT
EXPANSION CONNECTOR
1
2
3
4
5
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8
9
10
11
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13
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16
17
18
19
20
21
22
COMPONENT SIDE OF KIMI
ASCII KEYBOARD
STROBE
B3
B2
B1
B4
B5
B6
B7
-12V
+5V
1 GND
2 PA3
3 PA2
4 PA1
5 PA4
6 PA5
7 PA6
8 PA7
9
10
11
12
13
14 -PA0
15
16
17
18
19
20
21
22
APPLICATION CONNECTOR
5V DIP RELAY
TO XMTR
+5V
IN914
TRANSMITTER KEYER
7.5K
2N4124
.05
+5V
500Ω CT
8Ω
8Ω-2in SPEAKER
56K
2.2K
2N4124
SIDETONE OSCILLATOR
IN34,67

Fig. 1. Schematic for Morse code keyboard hardware. The A I/O port on the KIM is used as a parallel data link for the ASCII keyboard and as a serial output for the Morse code. This serial output can be used to switch a sidetone oscillator and/or a CW transmitter.

Up until the recent microprocessor boom, a project such as a Morse keyboard presented a formidable design, construction, and debugging project even for the well-versed hobbyist. The program presented here is a much easier software approach to this hardware problem using the KIM-I microcomputer by MOS Technology. The principles used to design this program are suited for other systems equipped with a programmable, read-write interval timer.

The KIM-I is equipped with such a timing device embedded within the architecture of its MCS6530 peripheral interface chip. This addressable timer is used extensively to define the timing of dots, dashes, spaces, spaces between letters, and spaces between words under program control. Reading and writing into the timer is just like an R/W operation in RAM memory.

The features of the software package are as follows:

1. Variable code speed from 9 to over 1,000 words per minute (for those of you who are bionic brass pounders).
2. 256 character First In, First Out (FIFO) buffer memory for typing ahead capability. The third page of RAM (0300-03FF) is used for this buffer storage.
3. Configuration software (I/O assignments and initializing) is provided for instant "GO" upon loading, or power turn on, if the user decides to use PROM for the program storage.
4. The program resides in a field of 256 bytes, which lends itself well to unexpanded systems (i.e., using just the memory available on the KIM-I board).
5. Excellent learning tool for self-instruction in Morse code.

The folowing guidelines were used for Morse code character synthesis: DOT = 1(t); DASH = 3(t); SPACE = 1(t); Space between letters = 3(t); Space between words = 7(t).

The interval timer on the KIM defines the basic time period, (t), under program control for character timing. The duration of this interval has been measured to be about 1.08 milliseconds, multiplied by XX_{hex}:

(t) = 1.08 milliseconds x (XX_{hex})
XX is any hex value from 01 to 7F.

The timing interval (t) ranges from 1.08 ms to 138.4 ms. The program fetches the code speed byte from 17BE in the KIM RAM. Before program execution is begun, the pro-

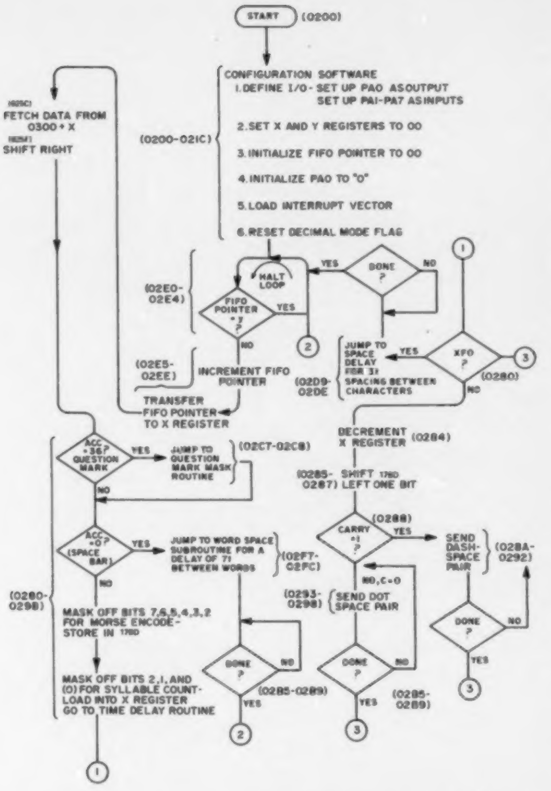
START
(0200)
CONFIGURATION SOFTWARE
1.DEFINE I/O - SET UP PA0 ASOUTPUT
SET UP PA1-PA7 ASINPUTS
2.SET X AND Y REGISTERS TO 00
3.INITIALIZE FIFO POINTER TO 00
4.INITIALIZE PA0 TO "0"
5.LOAD INTERRUPT VECTOR
6.RESET DECIMAL MODE FLAG
(0200-021C)
(025C)
FETCH DATA FROM 0300 + X
(025F)
SHIFT RIGHT
(02E0-02E4)
HALT LOOP
FIFO POINTER = Y ?
YES
NO
DONE ?
YES
NO
(02E5-02EE)
INCREMENT FIFO POINTER
TRANSFER FIFO POINTER TO X REGISTER
JUMP TO SPACE DELAY FOR 3t SPACING BETWEEN CHARACTERS
(02D9-02DE
XFO ?
YES
NO
(0280)
DECREMENT X REGISTER
(0284)
(0285-0287) SHIFT 17BD LEFT ONE BIT
ACC = 36? QUESTION MARK
YES
NO
JUMP TO QUESTION MARK MASK ROUTINE
(02C7-02C8)
ACC = 0? (SPACE BAR)
YES
NO
JUMP TO WORD SPACE SUBROUTINE FOR A DELAY OF 7t BETWEEN WORDS
(02F7-02FC)
(0260-0298)
MASK OFF BITS 7,6,5,4,3,2 FOR MORSE ENCODE-STORE IN 17BD
MASK OFF BITS 2,1,AND (0) FOR SYLLABLE COUNT-LOAD INTO X REGISTER GO TO TIME DELAY ROUTINE
DONE ?
NO
YES
(0285-0289)
(0288)
CARRY = 1 ?
YES
NO,C=0
SEND DASH-SPACE PAIR
(028A-0292)
(0293-0298)
SEND DOT SPACE PAIR
DONE ?
NO
YES
(0285-0289)
DONE ?
NO
YES
1
2
3

Fig. 2. Program flow chart for Morse code keyboard with FIFO buffer.

grammer must load the code speed byte into 17BE by hand using the hex keyboard on the KIM.

A value of $1A_{hex}$ in location 17BE yields a code speed of approximately 43 words per minute. A 20 wpm rate can be programmed by entering 37_{hex} in 17BE. 7F will correspond to 9 wpm.

The Morse characters are synthesized in dot-space or dash-space pairs. The completed character is followed by a delay of 2(t) to provide a total spacing of 3(t) so that individual letters are easily discernible. This spacing is added automatically by the program, and does not use valuable FIFO memory space. One depression of the SPACE bar on the ASCII keyboard provides a word spacing of 7(t).

Character Loading

The software has an interrupt routine that loads each key depression into successive memory locations in the FIFO buffer. This loading process occurs at any time during program execution, so that the operator is synchronously independent of the system. The interrupt routine for loading keyboard data occupies addresses 02CC-02D7. Each keyboard stroke is stored in successive memory locations beginning with 0300. The keyboard STROBE pulse is used to trigger the non-maskable interrupt (NMI) input of the KIM to signal the microprocessor that data is available for storage and processing. Thus, the Morse code keyboard is an interrupt driven device. (NOTE: Please observe the polarity of the STROBE pulse out of your ASCII keyboard. The NMI input of the KIM is normally high; if the STROBE pulse out of your keyboard is normally low, then you will have to invert it. I did this with my keyboard by using the $\overline{Q}$ output of the STROBE one shot.)

Character Fetch

Upon completion of stepping through the configuration software, the program jumps to location 02E0. If no data has been entered into the FIFO, the program enters a HALT loop by branching between 02E0 and 02E3. When data is loaded into the FIFO via the ASCII keyboard, the Y register is incremented to a value greater than the FIFO pointer in address 17BF. When these two registers are not equal, the character fetch from the FIFO begins and continues until the FIFO pointer has incremented up to the value contained in the Y register. The Y register points how far into the FIFO the last character was entered, while the FIFO pointer designates the next character to be fetched and processed. When the FIFO pointer in 17BF increments up to the value in the Y register, the machine has finally caught up to the operator, and the program reenters the HALT loop.

From ASCII to Morse

The conversion of ASCII into Morse code begins at 025C when a byte is fetched from the FIFO. Since PA0 (bit zero of the A I/O port) is used as an output, the ASCII entry ports have been shifted up one bit from PA0. This has the net effect of shifting the incoming data one bit to the left, even before the computer has asked to receive it. To compensate for this, the LSR instruction at 025F restores the identity of the parallel ASCII data by shifting it right one place.

As an example, assume that the ASCII code for C is in the accumulator after the LSR instruction execution. The ASCII code for C is 100 0011 or 43_{hex}. This value is transferred to the X register, then the accumulator is loaded with data at the calculated address of 0200 + 43 or 0243 as indexed by the X register. 0243 is in the LETTERS "lookup" table portion of the program. You will note that the contents of this address is $A4_{hex}$ or $1010\ 0100_2$. The encoding information is contained within this binary string.

Within this encoding byte are:

1. The type of syllable to be synthesized: dash-space or dot-space.
2. The number of syllables that will be synthesized to make that Morse code character. A syllable defined herein is either a dot-space or a dash-space pair.

The separation of these "subcodes" is performed by using the AND instruction in conjunction with a masking byte that will extract the information we need to execute the process.

To get the information in the first six significant bits from 1010 0100, this byte is ANDed with FC_{hex} or 1111 1100.

Case I:
1010 0100 (A4)
1111 1100 (FC)
1010 0100 RESULT

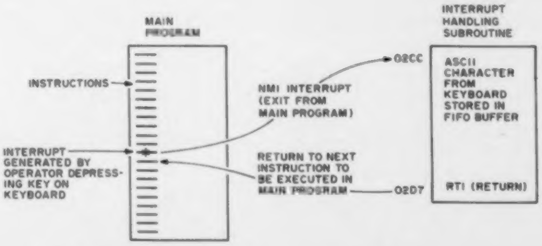
MAIN PROGRAM
INSTRUCTIONS
INTERRUPT GENERATED BY OPERATOR DEPRESSING KEY ON KEYBOARD
NMI INTERRUPT (EXIT FROM MAIN PROGRAM)
RETURN TO NEXT INSTRUCTION TO BE EXECUTED IN MAIN PROGRAM
02CC
02D7
INTERRUPT HANDLING SUBROUTINE
ASCII CHARACTER FROM KEYBOARD STORED IN FIFO BUFFER
RTI (RETURN)

Fig. 3. Software block diagram of interrupt operation.

Program listing.

```
0200   A9   LDA, imm            Start.
0201   01
0202   8D   STA, abs            Set PA0 as output, PA1 through PA7 as inputs.
0203   01
0204   17
0205   A9   LDA, imm
0206   00
0207   AA   TAX                 Clear X and Y registers, initialize PA0,
0208   A8   TAY                 and FIFO pointer (17BF).
0209   8D   STA, abs
020A   00
020B   17
020C   8D   STA, abs
020D   BF
020E   17
020F   A9   LDA, imm
0210   CC
0211   8D   STA, abs            Load low byte of NMI vector, CC, in 17FA.
0212   FA
0213   17
0214   A9   LDA, imm
0215   02
0216   8D   STA, abs            Load high byte of NMI vector in 17FB.
0217   FB
0218   17
0219   D8   CLD
021A   4C   JMP                 Jump to FIFO Buffer Fetch routine at 02E0.
021B   E0
021C   02
021D
021E
021F
0220   00   SP                  "Space bar" encode.
0221   8A   TXA
0222   48   PHA
0223   A2   LDX, imm            Load X with 06 for 7(t) word spacing.
0224   06
0225   4C   JMP                 Jump to time delay routine.
0226   AE
0227   02
0228   4C   JMP                 Jump to word spacing routine group at 02F7.
0229   F7
022A   02
022B
022C   CE   COMMA               Comma encode byte. Look up value for (,) key.
022D   18   SK                  SK encode byte. Look up value for (=) key.
022E   56   PERIOD              Period encode byte. Look up value for (.) key.
022F   36   QUESTION            Question mark encode. Look up value for (?) key.
0230   FD   '0'   — — — — —
0231   7D   '1'   · — — — —
0232   3D   '2'   · · — — —
0233   1D   '3'   · · · — —
0234   0D   '4'   · · · · —     NUMBERS lookup table.
0235   05   '5'   · · · · ·
0236   85   '6'   — · · · ·
0237   C5   '7'   — — · · ·
0238   E5   '8'   — — — · ·
0239   F5   '9'   — — — — ·
023A   55   :     · — · — ·     AR encode byte. Look up value for (:) key.
023B   95   ;     — · · — ·     DN encode byte. Look up value for (;) key.
023C
023D
023E
023F
0240
0241   42   A   · —
0242   84   B   — · · ·
0243   A4   C   — · — ·
0244   83   D   — · ·
0245   01   E   ·
0246   24   F   · · — ·
0247   C3   G   — · ·
0248   04   H   · · · ·
0249   02   I   · ·
024A   74   J   · — — —             LETTERS lookup table.
024B   A3   K   — · —
024C   44   L   · — · ·
024D   C2   M   — —
024E   82   N   — ·
024F   E3   O   — — —
0250   64   P   · — — ·
0251   D4   Q   — — · —
0252   43   R   · — ·
0253   03   S   · · ·
0254   81   T   —
0255   23   U   · · —
0256   14   V   · · · —
0257   63   W   · — —
0258   94   X   — · · —
0259   B4   Y   — · — —
025A   C4   Z   — — · ·
025B
025C   BD   LDA, x abs          Fetch next character from FIFO buffer.
025D   00
025E   03
025F   4A   LSR                 Shift fetched data one bit to the right to preserve
0260   18   CLC                 identity of the ASCII character.
0261   AA   TAX
0262   BD   LDA, x abs          Fetch Morse encoding info from the lookup table
0263   00                       as defined by 0200 + X.
0264   02
0265   8D   STA, abs            Store lookup value in 17BC.
0266   BC
0267   17
0268   C9   CMP, imm            Check if fetched data from FIFO is an ASCII code
0269   36                       for the QUESTION MARK.
026A   F0   BEQ                 Branch to QUESTION MARK masking routine at
026B   5B                       02C7 if accumulator = 36.
026C   C9   CMP, imm            Check if fetched data from FIFO is an ASCII code
026D   00                       for the space bar.
026E   F0   BEQ                 If space bar, branch to 0228 for JMP to 02F7.
026F   B8
0270   29   AND, imm            Extract syllable subcode.
0271   FC
0272   8D   STA, abs            Store syllable subcode in 17BD.
0273   BD
0274   17
0275   AD   LDA, abs            Fetch lookup value from 17BC.
0276   BC
0277   17
0278   29   AND, imm            Extract # of syllables to be generated, and load into
0279   07                       X register.
027A   AA   TAX
027B   4C   JMP                 JMP to 0280 to avoid the lookup value for DEL key.
027C   80
027D   02
027E
027F   8D   'DEL' (———)         BT encode byte. Look up value for (DEL) key.
0280   E0   CPX, imm
```

The first four significant bits are: 1, 0, 1 and 0. The 1s represent dashes and the 0s represent dots. The order in which dots and dashes will be sent from the computer is dictated by the arithmetic shift left (ASL) instruction. The ASL instruction shifts bit 7 to the left, into the carry bit, and zeros into bit 0. Thus the result of the first shift is:

(C)	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
1	0	1	0	0	1	0	0	0

Since the carry flag (C) is a 1, a dash-space pair will be sent. One more ASL will yield:

(C)	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
0	1	0	0	1	0	0	0	0

Since the carry flag (C) this time around is a 0, a dot-space pair will be cranked out.

The process continues until all of the syllables have been synthesized. The number of times that an ASL instruction will occur in the course of sending a complete Morse code character is determined by the three least significant bits, B_2, B_1 and B_0. Isolating these bits is done by ANDing the encode byte A4 with 07 as follows:

Case II:

1010 0100 (A4)
0000 0111 (07)
0000 0100 RESULT

The result of Case II is transferred to the X register. The X register is decremented for each (ASL) shift. When X has been decremented to 00_{hex}, a complete character has been processed. In this case, four (4) syllables are sent to synthesize the letter "C" (— · — ·).

All letters, numbers, punctuation and abbreviations are processed in this manner. When X has been decremented to 00_{hex}, the program branches to a subroutine that adds two extra timing intervals, 2(t), to the last syllable so that letter spacing is 3(t). This subroutine is located at 02F0-02F6.

Syllable timing and spacing are done by subroutine groups that funnel the program through one central time delay loop, 02AE-02C6, for maximum coding efficiency.

Special Keys

Provisions have been made for "lookup" table values for generating abbreviations and the punctuation marks used most frequently by hams.

1. The colon (:) key is coded to produce AR.
2. The semicolon (;) key is coded to produce DN.
3. The equals (=) key is coded to produce SK.

```
0281  00
0282  F0   BEQ          If X = 0, complete character was sent. Branch
0283  55                to 02D9 to insert 3(t) spacing between letters.
0284  CA   DEX
0285  0E   ASL, abs
0286  BD                Shift 17BD one bit to the left and monitor the
0287  17                status of the carry bit.
0288  90   BCC          If carry (C) is 0, send dot-space pair.
0289  09
028A  20   JSR
028B  A0
028C  02                DASH-SPACE subroutine group, 028A-0292.
028D  20   JSR
028E  A7
028F  02
0290  4C   JMP
0291  80
0292  02
0293  20   JSR
0294  A7
0295  02
0296  20   JSR          DOT-SPACE subroutine group, 0293-029B.
0297  A7
0298  02
0299  4C   JMP
029A  80
029B  02
029C
029D
029E
029F
02A0  8A   TXA          Save X on stack.
02A1  48   PHA
02A2  A2   LDX, imm     Load with 03 for delay of 3(t) for DASH.
02A3  03
02A4  4C   JMP          JMP to delay routine at 02AB.
02A5  AB
02A6  02
02A7  8A   TXA          Save X on stack.
02A8  48   PHA
02A9  A2   LDX, imm     Load X with 01 for delay of 1(t).
02AA  01
02AB  EE   INC, abs     Toggle PA0.
02AC  00
02AD  17
02AE  CA   DEX
02AF  AD   LDA, abs     Load code speed byte into timer.
02B0  BE
02B1  17
02B2  8D   STA, abs
02B3  07
02B4  17
02B5  CD   CMP, abs     Watch timer for count passed 00.
02B6  07
02B7  17
02B8  30   BMI          If timer has timed out, branch to check if additional
02B9  03                time periods are to be done.
02BA  4C   JMP          Jump back to recompare timer output.
02BB  B5
02BC  02
02BD  E0   CPX, imm     Check X for additional delays to be done.
02BE  00
02BF  F0   BEQ          If X = 0, interval timing is complete.
02C0  03
02C1  4C   JMP          JMP back to reload timer.
02C2  AE
02C3  02
02C4  68   PLA
02C5  AA   TAX          Restore X to pre-subroutine value.
02C6  60   RTS          Return from subroutine.
02C7  29   AND, imm
02C8  F8
02C9  4C   JMP
02CA  72
02CB  02
02CC  8A   TXA          Save X on stack.
02CD  48   PHA
02CE  AD   LDA, abs
02CF  00
02D0  17                Fetch data from the keyboard, and load it into
02D1  99   STA, y abs   the FIFO buffer, in location 0300 + Y.
02D2  00
02D3  03
02D4  68   PLA          Restore X to pre-interrupt value.
02D5  AA   TAX
02D6  C8   INY
02D7  40   RTI
02D8
02D9  20   JSR          Jump to LETTERS space, 3(t), delay routine.
02DA  F0
02DB  02
02DC  4C   JMP          JMP to FIFO FETCH routine at 02E0.
02DD  E0
02DE  02
02DF
02E0  CC   CPY, abs
02E1  BF
02E2  17
02E3  F0   BEQ          HALT if last character in FIFO was processed
02E4  FB                when Y equals contents of 17BF.
02E5  AD   LDA, abs
02E6  BF
02E7  17
02E8  AA   TAX
02E9  EE   INC, abs
02EA  BF
02EB  17
02EC  4C   JMP          JMP to fetch next character from FIFO.
02ED  5C
02EE  02
02EF
02F0  8A   TXA
02F1  48   PHA          Save X on stack.
02F2  A2   LDX, imm
02F3  02                Load X with 02 for a total space time delay
02F4  4C   JMP          of 3(t) between letters.
02F5  AE
02F6  02
02F7  20   JSR          JMP to word space, 7(t), time delay at 0221.
02F8  21
02F9  02
02FA  4C   JMP          JMP to FIFO FETCH.
02FB  E0
02FC  02
02FD
02FE
02FF

PROGRAM BUFFERS
17BF   FIFO pointer.
17BE   Code speed byte.
17BD   Syllable encode storage, the ASL is performed on this location.
17BC   Lookup value buffer storage.
```

4. The DEL key is coded to produce BT.
5. The period (.), comma (,), and the question mark (?) keys have been coded to produce their respective Morse code equivalents.

Operating Hints

In the interest of minimizing program listing requirements, the LETTERS lookup table, 0240-025A, was designed around the uppercase alphabet characters. The lower case alphas have been omitted for two reasons:

1. There is no distinction between upper and lower case letters in Morse code.
2. About 99.9% of existing software is written in upper case, and most teletypes, terminals, and ASCII keyboards that don't have the upper/lower case feature are coded for the upper case letters. Shift and lower case characters are not permitted.

The first step in the start-up is loading the program. Since the listing is quite lengthy, loading the program by using the hex keyboard each time the power is turned on is somewhat of a pain in the ASCII. I suggest that after you have checked your data entries, you take advantage of the audio tape dump program and hardware that is already on the KIM, so that you will have it permanently stored. Loading the computer from the cassette takes about 40 seconds for this particular program.

During the loading operation, the sidetone oscillator and transmitter switch will be enabled. A toggle switch, in series with the speaker to temporarily disconnect it until the system is configured by the software, is recommended.

Before you pass GO, be sure that you load the code speed byte in location 17BE. Use values less than or equal to 7F. In order to change the code speed after you have the program running, you will have to stop the program and load 17BE from the hex keyboard.

Since the KIM is a relatively new machine with little software support, you may have to move the program buffers, 17BC-17BF, to some other locations in the RAM memory space as new hardware and software are introduced and marketed. I chose to use those locations because they reside in the 64 byte RAM in the 6530 interface chip. This still leaves pages 00 and 01 free for expanding the program within the confines of my unexpanded system. ■

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Vienna VA 22180

It Works! The First Time!

- - the Seals Electronics memory board

It all started while I was looking through the June issue of *73* and came upon an ad for an 8K memory board. This particular ad made me realize that if the claims of the manufacturer were true, this board would be a very nice addition to my computer system.

Upon investigation of the manufacturer of this particular board (Seals Electronics) at the local computer club, I heard a very strange rumor. That is, that it was possible to obtain this 8K static memory board in only 10 days from the date that the order was received. I was quite sure that it was actually 100 days, but the temptation was more than I could resist. On June 16th I placed my order.

As soon as I dropped the order in the box I was gripped with fear, realizing that the interest on my money would probably be collected by the company for some time, at my expense. I resigned myself to receiving the memory board in 1977.

On June 23rd the postman came carrying a box three inches deep and a foot square. Sure enough, it was from Seals Electronics. I didn't open the box for a long while; I just stared at the box in disbelief and was somehow comforted by its shape. This must be a good sign, I thought.

Finally, I opened the box and peered inside. What a pleasant surprise. I viewed a large plastic envelope that contained four smaller parts packages. All of the components were of top quality. But what about the board? I quickly tore open the package that contained the board and examined it. It was beautiful! Not only was it first class in appearance, but it had no jumper wire holes. It had a solder mask on both sides and was silk screened on the component side. And, there was an assembly manual and two other documents.

I began reading the manual and, to my surprise, I could understand it. It was written in modern English, and even *I* could understand it. It described the assembly, installation and standby battery hookup. The theory of operation was described so that it could be easily interfaced with a home brew project. Could it be that this manual was written for the hobbyist? Two more pleasant surprises were yet to come. Upon examining the two remaining documents, I found a multicolor full size printed circuit board layout and a beautifully done foldout schematic of the board circuitry.

My enjoyment increased as I began construction. I followed the instructions and the memory began to take shape. First I installed the diodes, then the resistors, next the regulators, and then the address selection switches. Oh yes, and the *sockets*! This kit was supplied with sockets for all ICs! I was becoming convinced that a tremendous amount of thought had gone into the planning of this kit.

Another thing that struck me as I continued to build the kit was that all the holes were the correct size. Not once did I have to file down a lead and stand on my pliers to insert a component lead through the board.

The sockets fell into place and I even tried to make a solder bridge on the board, but was unable to accomplish this due to the almost foolproof solder mask. I was now convinced that anyone could build this kit without error if he simply followed the instructions. The last item of construction was the placement of the capacitors and this also went without a hitch.

Now for the ICs. As I began to insert the ICs in the sockets, another thought struck me. It was impossible to damage them with the old soldering iron.

Finished! I quickly looked the board over with my magnifying glass and, finding no problems, placed it before me with a sigh. After gloating for a few minutes, I picked up the card and headed for the computer. Snapping the address switches into the proper position, I then placed the board in the slot and prepared myself for the big moment. The familiar click of the power switch seemed to be more meaningful and the whir of the fan and lighting

"As the designer of the very first frequency counter, I congratulate you on a very neat design at an excellent price. Performance of this counter is really impressive..."

Richard K. Dickey

R. K. Dickey
Professional Electrical Engineer
(Designer of the world's first frequency
counter at Berkeley Scientific, 1949)

Thank-you, Mr. Dickey.

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of the LEDs joined in to indicate that all was okay.

Now for the test. First I addressed the memory and deposited a few bytes of data. Everything seemed to be working. Next I loaded BASIC into the memory and it worked flawlessly. It worked! And the first time, too.

When my wife called me to empty the garbage I realized that I was not dreaming. I began to consider what performance tests I might use to prove that this memory board was not all that it was cracked up to be. I was really challenged now, and was determined to find a problem with this board. After all, there just had to be some shortcomings somewhere! Besides, my reputation as a skeptic was at stake.

With these purist concepts in mind, I set out to test my newly constructed memory board.

My first plan of attack was to prove that no static memory could come close to my present dynamic memory in low power consumption. To accomplish this, I cut the three power leads between my last extender board and the other boards connected to the computer bus. I stripped one quarter inch of insulation from the free ends of all leads and melted some solder on the exposed wire to aid in soldering them during testing. I then resoldered two of the power leads, restoring normal operation to those two sources of power. I connected my ammeter between the two remaining leads.

The next step was to install two dynamic boards to give a total of 8K of memory. Placing them in the test location, I then applied power and recorded the ammeter reading.

I repeated this process with the two remaining power leads to the boards, and recorded the results.

Now for the new memory board. I installed it in the same manner and measured the five volt power line (the only one required for the new memory).

After comparing the results, I was surprised to find that the new low power static board consumed only twenty percent more power than the two dynamic boards. For all practical purposes, the power consumption is an even swap.

Not being one who gives in easily, I continued my testing. This particular board was advertised as having the memory of an elephant, or something to that effect. So I proceeded to examine this aspect of its operation.

There is a very unique feature built into this board; that is, there is a diode switching network between the normal power line to the memory and the battery standby line to the memory that is brought in on pin 14 of the memory board. (This position is not used on the bus line of the Altair and other similar computers.) This means you can connect a battery across pin 14 and ground, and when power is interrupted, the memory is automatically switched to the standby source to retain memory content.

To test this feature of the memory, I constructed a simple power supply capable of maintaining three volts under load when connected to the memory while the computer was turned off. I then soldered a small piece of wire on the free end of the extender board at location 14. The positive lead from the supply was connected to this wire and the negative lead from the supply was connected to logic ground (pin 50).

Not wanting to start in a small way, I loaded BASIC in the memory and immediately turned off the power. I waited for a few minutes, switched on the power, reloaded the first byte of data (location 0) that was lost by the computer, depressed the run switch and up came BASIC. This was a milestone in the operation of my computer system.

I then decided that a longer period of testing was needed. I followed the same procedure as before, but this time I left the computer off for 24 hours.

When I returned to resume testing I first touched the memory regulator heat sinks to determine whether cooling would be necessary during standby operation. They were cool! When I powered up the machine as before, BASIC came up without a problem.

By this time I was completely sold on my new 8K memory. I was patting myself on the back for what I thought was extremely good judgment on my part in selecting such a nice piece of equipment. (I have not been noted for this quality in the past.)

I pondered for some time after the completion of this testing to be sure that nothing else could be done by me to break down the resistance of the memory.

It then occurred to me that perhaps a good test would be to operate the memory with a disc operating system. Since I happened to have a brother-in-law with such a system, it seemed that a trip to his place was in order.

Upon arrival, we installed the memory board in his computer and, as you have probably guessed, it worked perfectly.

In conclusion, I would like to take my hat off to the folks at "Seals Electronics," and to what I believe is a long awaited answer to the dreams of the computer hobbyist. It is obvious that they have done their homework in producing a kit which can be built with more than a reasonable expectation that it will work when finished.

If you plan to purchase memory in the future (and who doesn't?), be sure to include this one on your list of considerations. I think you'll be very happy with it. ■

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William Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

The New Improved TT Decoder Updated

- - better

One of the things I have enjoyed most since I started writing for *73* has been the interchange of ideas with readers. I am always getting new ideas from calls and letters. My recent article on a TT decoder (April, 1976, p. 52) probably generated more interest and applications than any of the others. This short article is to share a couple with you.

Most users had to build up a supply or regulator in order to get the 5 volts required by the decoder board and, since I had quite a bit of room left on the board, I subsequently got the artwork redone to include an LM309H type regulator on the board. It worked out nicely and the regulator pads can be jumpered if the regulator is not wanted.

It's funny how small things can slip by, particularly where printed circuit boards are concerned. After I had wired several of the boards for people, I suddenly realized that I had not provided a PC pad for the negative power lead . . . back to artwork changes again.

A ham in the area who also uses commercial radio services came up with an excellent application and very useful modification of the basic circuit and board. The man has a business radio in his home and one in his truck, and uses them to contact his wife for messages, etc. The channel he is on is a common user channel with many other subscribers. His wife, as do many others, got tired of hearing all the other chatter on the radio all the time. The man decided to use my decoder to turn his base station speaker audio on and off. He could do the receiver modification himself and then acoustically couple the touchtones in his mobile radio.

The only problem that came up with this arrangement was that the wife couldn't turn the speaker back off locally after it had been functioned on. The application and the problem led me to the circuit modification shown in Fig. 1. The only change that had to be made was to add two diodes such as 1N4148s or 1N914s to the inputs of the "off" NAND gate and a normally open push-button switch. The switch then shorts the diodes to ground, causing the output of the gate to go high and reset the output latch. In this case the user mounted the small push-button directly on the front panel of his commercial base station and the circuit board fits easily inside the radio. He is using the decoder relay contacts to interrupt the speaker audio.

This is just one of many possible applications. Many people have built the circuit to control autopatches using a "*" on and "#" off. If you have used this circuit for some neat application, I would be very happy to hear from you. ■

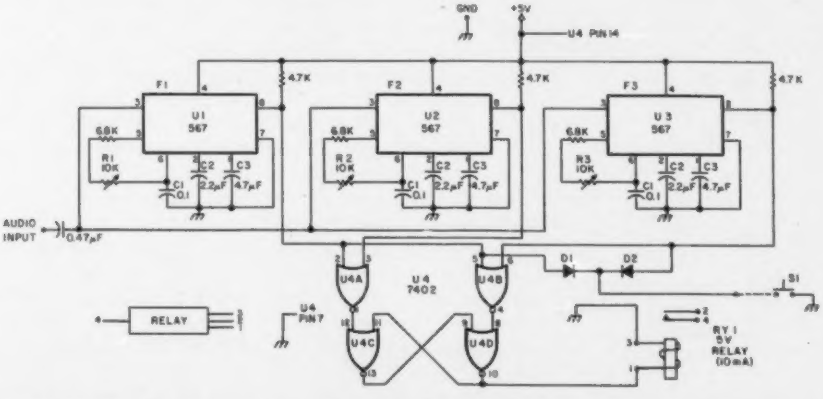


Fig. 1. Tone decoder with added regulator circuit and manual reset circuit. Diodes D1 and D2 (1N4148/1N914) are added to the circuit board and S1 shorts their junction to ground. Printed circuit boards are available from CONTACT Electronic Research and Development, 35 W. Fairmont, Tempe AZ 85281 for $5.50 postpaid. Wired and tested versions are also available.

The Polarity Changers

- - plus to minus

73 Magazine *Staff*

A problem often arises with some IC or transistor circuits when just a modest amount of negative voltage is needed to bias a switching circuit or to power an IC circuit stage that works best when it is powered from equal positive and negative supply potentials. For home station equipment, this situation is easily resolved by constructing a power supply which provides the necessary positive and negative outputs. For battery-operated equipment, an extra battery can always be provided, but this adds to bulk, eventual cost and perhaps even erratic operation at some time since the separate batteries used for positive and negative supply voltages will not age at the same rate. The greatest problem is usually with adapting such circuits to mobile operation where only +12 volts is available. Either a battery for a negative supply has to be used, the circuit modified for single supply operation or, as is usually the case, the idea given up of using a particular circuit for mobile operation.

This article describes a number of ways by which a negative supply voltage can be generated when only a positive source is available. Those who still remember vacuum tubes may also remember that this was also a problem then for mobile operation when tubes required a negative bias voltage. The usual solution was another winding on a vibrator power supply transformer or on a dynamotor. But, some manufacturers even then did try more ingenious approaches, and they are the basis of the circuits that are used these days to generate that needed negative supply potential.

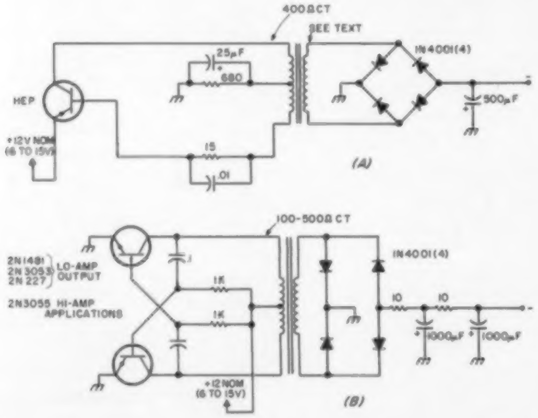


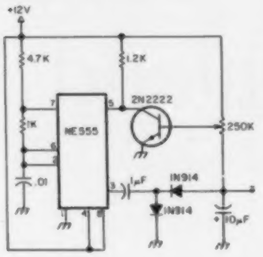
Fig. 1. Two forms of oscillator circuits which can be used to form a negative voltage supply. Output voltages and currents are available over a wide range depending on the transistors and transformers used as explained in the text.

Basically, there are two approaches that can be used to generate a negative ground potential when only a positive to ground potential is available. One is to build an oscillator (anywhere from audio to rf) which has a transformer output isolated from ground. The transformer output is treated like the secondary of an ac transformer (rectified and filtered) to produce a negative voltage. In tube days, rf oscillators were popular because high voltages for bias purposes could be developed across their tuned circuits. The other basic approach is to use a switching circuit to charge a capacitor with a positive supply. But, between charging intervals, additional circuitry literally lifts the capacitor up and turns it around with respect to ground, and it supplies a negative potential. So, the capacitor is alternately charged and electronically flipped around and discharged.

The following oscillator circuits are not the simplest form of positive to negative supply generators possible. Still simpler circuits are possible but they require special transformers, whereas the two circuits shown need only simple, readily available parts.

The circuit of Fig. 1(a) is basically just an audio oscillator with a transformer coupled output. It can be constructed using a wide variety of PNP general purpose transistors and with transformers having varying turns ratios so that output voltages of from 6 volts to 20 volts can be obtained. The secondary voltage is then rectified using a standard bridge rectifier circuit and a 500 mF filter capacitor. Not too much filtering is required since the oscillator produces a fairly good sine wave output. One may have to connect miniature transistor output transformers back-to-back to

Fig. 2. The inexpensive 555 timer IC is the heart of this negative supply which provides a variable output up to -10 volts. Note that the 1 mF capacitor by pin 3 is not an electrolytic type.



obtain a desired output voltage, depending on which types are available locally. For instance, one might use a 400 CT to 8 Ohm transformer back-to-back with an 8 Ohm to 10k transformer to get a voltage step-up. Some experimenting and breadboarding is necessary, but just about any desired voltage can be generated by using different transformer ratios and types of rectifier circuits (half wave, full wave or bridge). Generally, using low power transistors and the usual 99 cent 300 mW transistor transformers, output loads of up to 10 mA can be accommodated.

Fig. 1(b) is a standard multivibrator circuit with component values chosen so it operates at about 7 kHz. The idea is basically the same as in Fig. 1(a), but this circuit produces a square wave output and, depending upon the power transistor used, output currents of an Ampere or more can be generated at various voltage levels. Some 24 CT filament transformers will work well in this circuit. Otherwise, standard transistor output transformers have to be used either singly or back-to-back to get the desired step-up in voltage. Transistor output transformers or interstage transformers rated as 1 Watt, such as Stancor TA-4 or Allied 6T8HF, will do nicely with any of the low/medium power transistors mentioned in Fig. 1(b) to produce outputs in the 12 to 15 volt range at up to 100 mA load. The square wave output of the circuit requires that a bit more elaborate filtering be done, as shown in Fig. 1(b), to get a smooth dc output. Also, square wave generators will have rich harmonic outputs. The 7 kHz operating frequency for the multivibrator is a compromise between an operating frequency that is above the audio range of most audio communications circuits with which it is likely to be used and yet within the efficient frequency operating range of most inexpensive transformers. Nonetheless, if the supply is to be used with rf circuitry, careful power supply bypassing to the multivibrator and even shielding in extreme cases may be necessary to prevent hash in the rf circuits.

The circuits of Fig. 1 should satisfy most needs and can be built reasonably inexpensively. However, in these days of ICs, it would not be fair to omit some more sophisticated approaches to the negative supply voltage problem. Both of the following circuits appeared originally in *Electronics* and provide negative voltage generation along with regulation of the output voltage.

Fig. 2 uses the ubiquitous 555 IC timer. The 555 is operated as a free-running pulse generator. The pulse output frequency and pulse width are basically set by the RC components between pins 7, 6, 2 and 1. However, a control voltage applied to pin 5 can vary the pulse repetition rate. Output is taken from pin 3 where first a capacitor isolates the output from a ground reference and then the output is rectified and filtered. The output voltage level can be set anywhere from 0 to -10 volts by the potentiometer in the base of the 2N2222. This potentiometer, for any given setting, compares the output voltage to the supply voltage. If the output voltage decreases, the 2N2222 is turned further on, causing the control voltage on pin 5 to come closer to ground and hence to increase the pulse output rate. This, in turn, charges up the output 10 mF capacitor more often and brings up its voltage. The quality of the regulation depends on the output current demanded. It is about 5% at 10 mA output. Greater outputs can be supplied but then the regulation will become poor.

Fig. 3 shows another supply/regulator circuit that can supply fixed output voltages over the range of about -5 volts/30 mA to -15 volts/13 mA from a +15 volt supply. Thus, it can supply a bit more current than the circuit of Fig. 2 and can supply -12 or -15 volts when a +12 or +15 volt source is available, which is an advantage in many applications using operational amplifiers. The circuit uses an IC hex-inverter and a single transistor. Two of the inverters form a square wave oscillator. The other four inverters are paralleled as drivers. When the output goes positive referenced to ground, the 1 mF capacitor charges through the 1N914 going to the collector of the 2N3904. When the output goes towards ground, charge is transferred from the first 1 mF capacitor to the output 1 mF capacitor as the second 1N914 conducts. The output 1 mF capacitor now has a voltage across it which is negative referenced to ground. This transfer of charge between capacitors continues until the voltage buildup across the output 1 mF capacitor breaks down the zener diode. Then, the 2N3904 is turned off and the transfer of charge stops until the load current drain again causes the output voltage to fall below the zener voltage. Thus, the circuit is self-regulatory.

The circuit as shown will produce only 5 volts negative output from a positive 15 volt supply. This can be increased by using the alternative voltage multiplying circuit shown in Fig. 3 to produce -15 volts. -12 volts can be produced from a positive 12 volt supply with the same circuit by using an approximately 13 volt zener. The 74C901 hex-inverter operates from up to a positive 15 volt supply and can produce a full -15 volts when used with the voltage multiplying circuit. However, if only a positive 5 volt source is available and -5 volts is needed, the basic circuit of Fig. 3 with the voltage multiplying circuit can be used with a simple SN7404 hex-inverter. An approximate 5.6 volt zener will suffice for the zener reference diode in the base circuit of the 2N3904.■

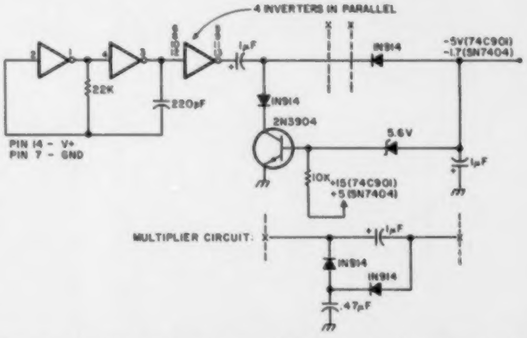
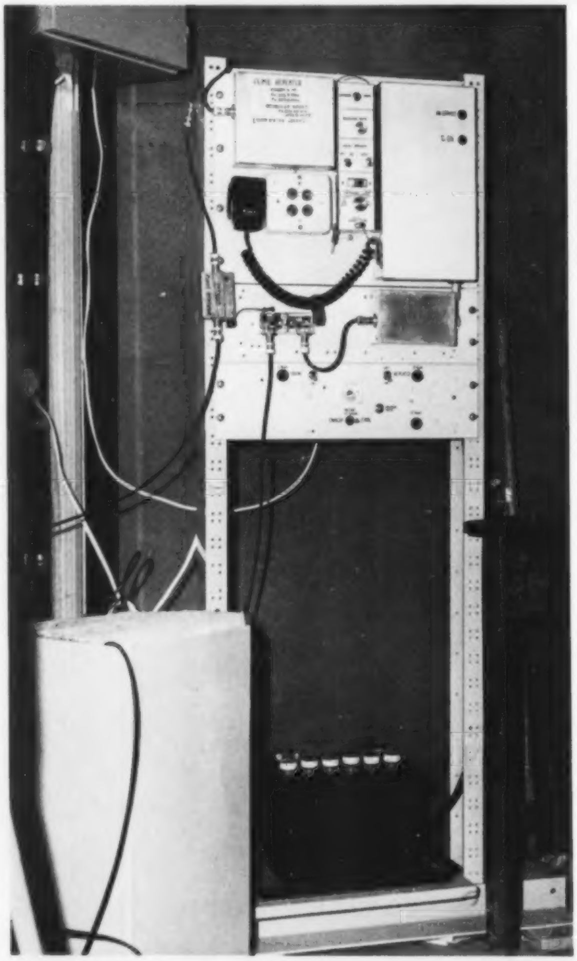


Fig. 3. Negative voltage generation circuit using a hex-inverter IC. If the multiplier circuit is inserted between points X-X, the basic output voltage will be the same as the positive supply voltage. The zener in the base of the 2N3904 must always be rated at 0.6 to 1 volt more than the final negative output voltage.

Repeaters in New Zealand

- - quite a few

Fred Johnson ZL2AMJ
15 Field Street
Upper Hutt, New Zealand



The Mount Climie FM repeater. Note the battery (below) and antenna filter box (left bottom).

FM repeaters hit ZL some five years ago, and since then have spread across the land. With a population of 4800 licensed amateurs, some 24 FM repeaters are now in operation, or about to become operational.

New Zealand is a land of mountains, lakes, rolling hills and open plains, and repeaters have helped to make VHF popular by overcoming terrain problems. The land in the region of Wellington, the capital, is all hills and valleys. People live in the valleys, and without repeaters VHF operation would be very limited for all but a few operators with hilltop sites.

The national radio amateur body is the New Zealand Association of Radio Transmitters (NZART), which has 75 branches. The licensing authority is the New Zealand Post Office (NZPO). NZART set up a committee some years ago to develop a band plan for the two meter band and to coordinate repeater development. In addition to the FM repeaters, some areas also have an AM repeater, and there is at least one two meter beacon station in each of the four ZL call districts.

ZL amateurs are fortunate in that the NZPO, while retaining the right to issue the license for a repeater, accepts to a large extent the views and requests of the VHF committee. So the amateurs have the responsible task of organizing their own band and repeater plan, ultimately seeking an NZPO license when all the various negotiations about sites, access, and other responsibilities have been ironed out and the need for the proposed repeater has been established. Most repeaters have been established to meet a Civil Defense or an Amateur Radio Emergency Corps requirement.

In the event of some disaster or emergency, the amateurs turn out to provide communications for the Search and Rescue Organization, the police, or Civil Defense authorities. Each NZART branch has an "E" series of callsigns allocated so that it is easy to tell when emergency traffic is using a repeater. For example, the Upper Hutt branch has the call series ZL2ELA to ZL2ELZ available. When E calls are heard on the repeater, normal amateur chitchat stops to allow the emergency traffic priority.

The relationship between New Zealand radio amateurs and the New Zealand Post Office is extremely good and in this we are very fortunate. New Zealand is one country where amateur radio is understood and supported by the authorities. In this regard, the IARU problems with WARC 1979 get both NZART and NZPO support.

The two meter band plan started out with four FM repeater channels and this was later extended to six. It can again be extended if found to be necessary. The following channels are in current use:

Channel A – 146.20/145.50
Channel B – 146.225/145.525
Channel C – 146.30/145.60
Channel D – 146.35/145.65
Channel E – 146.40/145.70
Channel F – 146.45/145.75

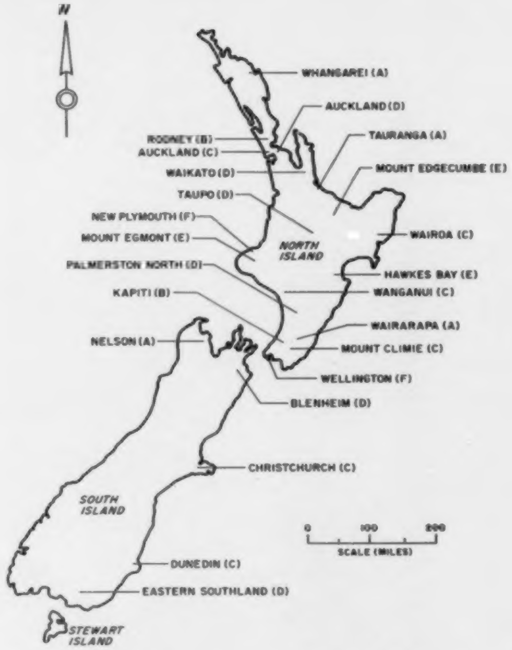
All repeaters are home-constructed, there being no off-the-shelf supply available. An enthusiast in one of the local branches of NZART usually constructs the repeater and finally becomes the "trustee" for the NZPO license.

All repeaters are open access; "closed" repeaters are not permitted. Carrier-operated entry is the rule. No tone-entry systems have been found to be necessary. The geographical spread and siting have made possible an almost exclusive channel allocation to each repeater. During hot summer weather, DX operation between repeater areas becomes possible. This is regarded more as fun than a nuisance.

The NZPO has not required a callsign or an identifier system for repeaters. All repeaters must be owned by a branch of NZART, and a member of that branch is the trustee for the repeater license. Repeaters cannot be owned by an individual. So the station using the repeater (i.e., the user callsign) and the trustee are responsible for the operational performance and operating discipline. In practice, this means that all repeater users have a responsibility to maintain a satisfactory standard of operating procedure. It seems to work out OK. "Repeater Rules" appear annually in the NZART Callbook. These reflect local operating practice:

1. The Trustees (as listed on the Post Office license) to have final responsibility for the repeater operation.
2. The repeater to be owned and maintained by the Branch.
3. The repeater to be open for use by all licensed amateurs.
4. Amateur Radio Emergency Corps and Civil Defense requirements in areas to have priority use over normal amateur traffic.
5. "Overs" to be kept short.
6. Breaks between "overs" to be frequent to let other users identify and call in.
7. Stations who can work together direct without using the repeater establish contact only and then change to some other channel.
8. Home station to home station contacts are discouraged.
9. The Radio Regulations to apply at all times, notwithstanding anything in these rules.
10. With the exception of mobiles, stations should not call a general CQ.
11. Stations using the repeater to identify when calling.
12. No one to be excluded from legitimate operation.
13. QSLs should be clearly marked "via repeater."
14. Contacts via the repeater will not be recognized for any contest or award.
15. A copy of these rules and the names of the Trustees to be posted on the Branch noticeboard.

The map shows the geographical layout and the channel allocations for the FM repeaters. Such a simple map cannot show the site and propagation considerations leading to the choice of each site. Recourse should be made to more detailed maps for this background.



Map of New Zealand showing location and channel of two meter band FM repeaters.

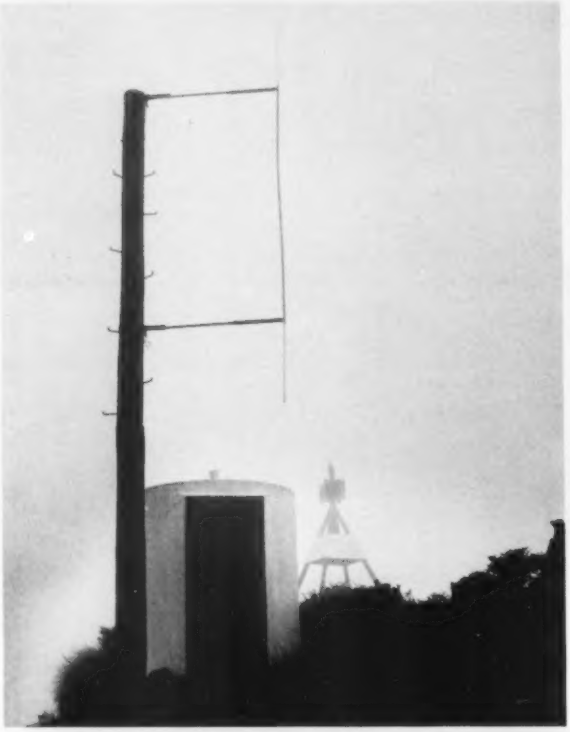
The highest repeater is on Mount Egmont, an 8620 foot high volcano. The repeater is sited about 3500 feet up the eastern slope of the mountain. One repeater (at New Plymouth) is destined to be sited on top of a 600 foot power station chimney. Most amateur repeaters live on someone else's premises, generally owned by the NZPO, the Broadcasting Council or the Civil Aviation authorities. One repeater which has its own hut is the Mount Climie repeater on "Channel Charlie," for which I am trustee.

Establishing "Charlie" has probably been typical of setting up a repeater anywhere: Negotiations for site, underground power cable to the site, a building, a pole, and so on, all had to be arranged. The hut was made by a concrete products firm, who said that they could deliver their product. When they heard that it was wanted 2823 feet up atop Mount Climie they still stuck to their word! A steep road gives good weather access, 11 miles from the Upper Hutt branch NZART clubrooms. The site is sometimes snowed in during winter.

A 200 yard long power cable trench was dug into the hilltop by branch members to get the 230 volt 50 Hz supply to feed the repeater. This is taken from a local microwave station.

The power supply authority had to erect an overhead line on poles to supply the microwave station. After some talking they agreed to provide an antenna pole for the repeater. This they delivered by helicopter and lowered into the hole – which they also dug!

Financing for the installation was obtained by selling kit sets for various branch construction projects. One such project was an FM transceiver kit known as the "Climie Transceiver." Some 110 of these were sold as kits and are in current use on various repeaters. Bulk buying of components and no labor or overhead charges enable branches to raise



The cloud-enshrouded Mount Climie FM repeater site. The trig station (behind) is for a spot height of 2823 feet. The antennas are in two identical sections — receive on top, transmit below. Each is a two half-wavelength collinear, fed with a balun and matching stub at the center. Steps on the wooden pole are an aid to climbing. The hut is reinforced concrete with a steel door.

money through kits.

The Upper Hutt branch of NZART is responsible for Civil Defense communications in the local area, and the cost of the power used at the repeater site has therefore been arranged to be met from the funds of other people! The branch is in the fortunate position of having a hilltop site and a repeater free of debt and free of running costs. It is serviced and maintained by voluntary effort. Contacts are possible at almost any time throughout the 24 hours because the channel is monitored by many people. It has been used for many emergencies and many exercises.

The "Channel Charlie" repeater runs off a float-charged 12 volt battery. It is all solid state and does not use mechanical relays or tubes. Several alarm circuits are fitted. One alarm shows up when the 230 volt ac main supply to the hut fails — to warn users that the equipment is running on the raw battery only. The other is an intruder alarm on the hut door — to advise unauthorized entry. The repeater can be shut down remotely by the trustee should this be necessary. Other facilities are in the process of experimental development.

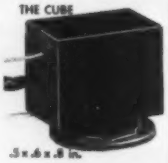
So far, only the two meter band has been used for repeaters in New Zealand. The band extends 144 to 148 MHz. The 70 cm band plan is in the process of being polished and some groups are keen to see some repeaters established on that band. No crossband repeaters are envisaged and the linking of repeaters has not yet happened or been thought desirable.

Three grades of amateur operator certificate are in use in New Zealand. A Grade I certificate holder can use any amateur band. A Grade II certificate holder can use all bands except 40, 20, 15 and 10 meters; i.e., he can use 160, 80, 6, and all amateur frequencies above 144 MHz. A Grade III certificate holder is restricted to voice communication on bands above 144 MHz only.

There is one common theory and regulations examination set by the NZPO. Passing this examination alone can assure a Grade III certificate. Passing a Morse test at 12 words per minute in addition gets a Grade II certificate. With additional operating experience on 80 meters, a Grade I certificate can be obtained. The result is that the usual pattern is for the budding amateur to get a Grade III certificate first and later graduate to the other bands. This means that the new amateur has immediate access to VHF repeaters; this has contributed to extending the popularity of repeater operation. Grade III licensees are indicated by the "T" series of callsigns, e.g., ZL2TCU.

Visitors to New Zealand who hold an amateur license issued in certain overseas countries (including USA) can obtain a license to operate while in New Zealand. The "reciprocal licensing" arrangements vary from country to country. The address for enquiries is the Radio Section, New Zealand Post Office, Post Office Headquarters, Wellington, New Zealand. Several weeks notice should be allowed.

Visitors are welcome on all ZL repeaters. Operation on a repeater is an easy means to learn of local amateur club meetings and of other activities. Shack crawls and eyeball QSOs can soon eventuate once a strange or a new callsign appears on the repeater. See you in ZL? ■



SUB-AUDIBLE GENERATOR for FM

THE CUBE

.5 x .6 x .8 in.

- Inexpensive multi tone encoder
- Compatible with PL-CG-QC
- Low distortion sinewave
- Input 8-18 VDC unregulated
- Rugged, plastic encased with leads
- Adjustable frequency (98-250 Hz), Lower available
- Excellent stability

Price $19.95

Freq. set at factory $5.00 extra

Calif. res. add 6%

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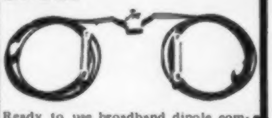

DOUBLE BAZOOKA DIPOLE

Ready to use broadband dipole complete with central insulator and S0239 connector end insulator completely water proof cap. 1000 watts, specify center frequency. 80 meter — $29.50, 40/15 meter — $27.50, 20 meter — $23.50.

5 band trap dipole KIT complete, includes 80-40 trap central and end insulator antenna wire, 100 feed of RG59, 1-pl259 connector and instruction sheet . . .$35.00

Fiberglass central insulator similar to photo above. 1000 lbs test . . . $5.95 ppd.

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KAUFMAN BALUN

KAUFMAN water tight BALUN

new and improved molded plastic

1:1 impedance match

with or without BALUN

Patent No. D219106

For dipoles, beams, inverted "V", and quads

KAUFMAN Center Insulator with BALUN $13.50
KAUFMAN Center Insulator without BALUN $ 8.50
Dragon Fly antenna construction sheet and drawing
postpaid USA $ 2.00

3 Kw PEP
4 Ounces
Q1 Ferrite

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Briefs

WR6ABE: over 700 users, 15 years on the air, extraordinary coverage throughout Southern California, one of the first big repeaters on the West Coast, but now a silent key, at least until early in the new year. K6OQK, the owner of the repeater, took it off the air in late October, hoping a cooling off period might end the QRM, obscenity and assorted garbage that's been wrecking the system for months. In the view of more than one reporter, ABE's problems grew from a small minority, plus its incredible coverage of the Los Angeles area. As Arny Gamson K6PXA, editor of *Scatter* (the journal of the Southern California Teleprinter Society) put it: "Is this a trend in ham radio where a very small percentage of jammers, drunks, and inconsiderates can ruin it for the majority?" We hope not.

The 20 meter jammer, heard for weeks and believed to be of Russian origin, is finally QRT. The incredible "buzz saw" noise was heard over a wide range of frequency, running from 40 through 15 meters here on the east coast. Despite international protest, the jammer persisted until early November. In fact, no one is really sure if the "buzz" was a jammer at all. W6PN, a former director of engineering for Radio Free Europe in Munich, is quoted as saying the noise was not a jammer. Instead, he says in the British *Short Wave Magazine*, "Its millisecond pulses, overmodulated at about 5 kHz, would be more suitable for propagation studies or some wide band operation."

Anti-antenna zoning harassment to hams and CBers is increasing throughout the country. In the latest case, an Illinois amateur has filed suit in an effort to prevent his city from forcing him to remove his 72 foot tower and antennas.

Walter Weber WA9FXG of Orchard Place IL first erected his tower last April. He was later told that he needed a building permit, after neighbors complained that the tower posed a danger to residents and interfered with their television reception.

When it was later decided that the tower violated the 35 foot building height limitation in his area, Weber sought a zoning variance. While the local Zoning Board recommended its approval, it was subsequently denied by the Orchard Place City Council who said they feared approval would set a precedent for other types of structures.

Weber's suit asks that the court declare the city's building code unconstitutional or declare that the height limitation does not apply to radio towers. He contends that defining a tower as a building is too broad and makes the building code vague. Weber added that many roof mounted television antennas exceed the height limitation.

There's help coming for amateurs who've run amuck of local zoning and interference laws. A national group of attorneys and judges, who are license holders in both the amateur and citizens band services, have formed the Personal Communications Foundation, a nonprofit, soon to be tax-exempt California corporation. Using thousands of their own dollars to get started, they plan to establish liaison and working committees to deal with issues like land-use restrictions, tower ordinances, deed restrictions, TVI-RFI and nuisance problems, and the related problems of jamming and other unlawful operating practices.

The cost is estimated to be about 80 thousand dollars for the first two years of organization, with the operation becoming self-supporting thereafter. The lawyers won't be making any money . . . to the contrary, the organizers are actually losing funds out of their own pockets to get PCF rolling. There is no affiliation with ARRL, or any other organization, although PCF is seeking advisory help. The organizers say if one dollar could be donated by one out of every three US and Canadian amateurs, within a year PCF could have a list of attorney liaisons available for publication.

According to one of PCF's founders, Los Angeles Attorney Jon Gallo WA6PTM, attorneys across the US have volunteered to open their files. That way, Gallo says, any individual could receive information from the foundation to help overcome communications-related legal difficulties. Local ordinances are being enacted not only banning towers over 35 feet and large antennas, but setting penalties for TVI-RFI as well!

PCF says it knows of such ordinances in 47 states, with at least five cases resulting in fines to licensed CBers for TVI-RFI. It's easy to see, PCF reasons, that amateur licensees are bound to be affected. The idea, says Gallo, is to cut the cost of defending hams and CBers by providing a national clearinghouse of legal information for attorneys. PCF emphasizes it will not actually defend anyone . . . but instead will try and cut the legal bills a tower fight or TVI case can bring. Stay tuned for further details.

The battle continues over operation of the Port Chester NY 34/94. A 15 signature petition demanding discontinuation of operation has been denied by WR2ABE trustee Michael Troy WA2TYV. Edward Zeiser WA2OQO apparently led the petition drive, claiming "unmitigated interference" to 146.34 and 146.94 simplex operation on Long Island. Zeiser addressed his petition to Stan Zak K2SJO, Hudson Division Director of ARRL. It turned out Zak had no connection with WR2ABE other than a wire line control point, given as a courtesy since he is local CD chief. In answer to the petition, WA2TYV suggested putting an end not to the Port Chester repeater, but instead to operation of 34 for simplex purposes. "Today's FM gear allows plenty of room for simplex, both above and below 146 MHz . . . while repeaters are restricted to the 146-148 MHz segment; no ham is forced to stay on 34 or 94 simplex."

In Ohio, Robert Scott W8SFK has printed a thousand protest letters, blasting the Ohio Repeater Council for assigning FM repeaters on 146.10 to 146.70 MHz. Pointing to gentlemen's agreements making 70 a national RTTY frequency, Scott terms the council's action "a flagrant violation of trust and a miscarriage of integrity." Scott argues that the very founding principles of the council are self-policing, common sense, good judgment, and a gentleman's agreement. According to Scott's letter of complaint, a new 10/70 near Findlay OH is disrupting simplex teletype in the entire northwestern quadrant of Ohio, the southern tier of Michigan, and northeastern Indiana, along with over 20 operators in greater Toledo. The Ohio Repeater Council has another point of view. Wrote George Hinds WB8JYR (the OARC Chairman), "Indianapolis, Cincinnati, East Liverpool, Cleveland and now Findlay have voice repeaters on 10/70 . . . The first three have been long established . . . The only operational RTTY repeater in the same region is Detroit on 22/82, not 10/70." Hinds went on to suggest there are many other frequencies on 2 meters for RTTY. "You have no more 'grandfather' rights to work simplex on the repeater segment of 146 MHz than did the fellows who long cherished 94 as a simplex frequency . . . Faced with the facts, not with dreams of the 'good old days' when 146-147 MHz were barren wastelands, OARC can no more sanctify 146.70 for you than we could keep repeaters off 94, 76, or 88, all of which at one time were simplex."

Icom East Distributor Kayla Bloom Hale W1EMV has resigned. Hale, a former editor of *73*, says she plans to retire to her Dublin NH home and do some writing, hamming, and relaxing. Kayla says she's tired of the grind, the never-ending shows, the thousands of miles of travel each year. On ham radio Hale is optimistic. "It's on the way up, just like the sunspot cycle . . . with a lot of CBers becoming disillusioned and turning to ham radio . . . I just hope they don't ruin it." In February of 1968, when Kayla became editor of *73*, she wrote some similar thoughts. "I was one of the 'save 11 meters' group way back when . . . since we lost the fight, I have not paid too much attention to what is going on on 27 MHz . . . Recently, after listening to the CB band, I was completely stunned by what I heard . . . Calls like, This is the 'Barefoot Boy' calling 'Yankee Pirate' . . . I feel certain these calls were not issued by the FCC . . . Amateur radio gave up 11 meters for this?" Things haven't changed much in 8 years, have they?

El Paso TX has a new repeater, designed for solar powered operation on top of North Mt. Franklin. Operation began October 9th on 146.10/70 MHz. The machine uses only about 11 mA on receive, about 500 mA transmit, with a power output of 2 to 3 Watts. Telemetry will be used to remotely monitor the repeater, using the output of the club's companion 28/88 machine. To conserve power and eliminate kerchunking, the COR is VOX operated. Still to be completed at press time was the machine's ID, telemetry, and control boards. An enclosure will also have to be built on the mountain to house the equipment. Except for Hallicrafters PC-18 boards, the entire repeater is home brew. That includes the cavities! Coverage is expected to be at least 100 miles in all directions with HT coverage of El Paso, Las Cruces and Alamagordo.
Reprinted from The Beam, *Bulletin of the Sun City Amateur Radio Club, El Paso TX.*

The denials persist, but Icom has indeed discontinued the much-loved IC-230 2m transceiver. Replacing the 230 is the IC-245, featuring continuous VXO tuning, 144-148 MHz, and programmable offsets. Priced at $499.95, it is seen as a prime competitor for the new Kenwood TR-7400A. Further Icom-Kenwood competition can be expected between the proven TS-700A and new Icom IC-211 base all-mode rig. Sales of the IC-22S continue to back up the dealers, with Engineering Specialties, a West Coast firm, offering the first commercial outboard encoder for the rig's diode matrix synthesizer (see New Product review this issue). We've also learned that Icom will release its first lowband radio early this year. A low power rig with digital readout, the Icom will cover 80-10 meters, will be super compact, and can be expected to be only the beginning HF-wise if well received.

FCC district offices are expected to begin using multiple choice comprehensive code exams in early January. The only possible holdup at press time was the government's contract for dupes (copies) of the newly recorded code exams. According to an FCC spokesman, the decision to switch to multiple choice was not based on a desire to make the code exams easier . . . but rather to make the tests fair. One official told *73* it was the Commission's belief many applicants were failing code exams due to nervousness, not a lack of code proficiency. Technician class applicants can expect 10 multiple choice questions for the 5 wpm test, General and Extra class applicants could see longer code questionnaires, but that was not certain at press time. Written exams, incidentally, break down to about 50% rules, operating procedures, and communications practices for the Novice, Technician, and General classes . . . with the remaining questions on radio principles and practices. The balance for Advanced and Extra is about 40-60, according to the same FCC spokesman.

The FCC continues to unlock the door on 1 x 2 callsigns. Latest batch covers N and X calls, with all Extra licensees eligible starting July 1977 (see FCC News Release).

John Lassig K5GFV has petitioned the FCC for amateur privileges on the 11m CB band. Lassig argues ham operation, under CB rules and regulations, would actually help FCC enforcement efforts and probably bring scores of CBers into ham ranks. (Lassig's petition appears elsewhere in this issue.)

At press time the crunch of new license applications had only begun to take effect in Gettysburg. With hundreds of Novice classes starting up all over the country this fall, it seems inevitable delays will be the result. Turn-around time, despite the expected crunch, was nothing short of unbelievable in mid-November. Using the special amateur radio post office box number 1020, and printing "Amateur Radio Novice Application" across the lower left of the envelope, brought written exams in less than 10 working days! It might help to write "Completed Amateur Exam Enclosed" on the return envelope as well. Again, that's FCC, PO Box 1020, Gettysburg PA 17325.
Thanks to Kettle Drums, *bulletin of the Kettle Moraine Radio Amateurs, Waukesha County WI.*

Confusion reigned among Technician class licensees during early November, as the FCC computer at Gettysburg fouled up those Novice class call reissues. The result: WN calls on repeaters and several cases of mistaken identity. The Technicians have been advised to use the WN calls until the computer errors are corrected. Novices, incidentally, received somewhat frightening letters from FCC . . . informing them that their tickets had been revoked and warning them not to use the WN prefixes. The second paragraph of the letters went on to inform them of their new WA-WB-WD calls . . . but we hear things got a little shaky upon opening those unexpected envelopes.

Clegg Communications, after going direct and eliminating the dealers last year, is now offering quantity price discounts on 2 meter and 220 MHz radios. Affected are the Mark 3 15 Watt 2 meter transceiver and FM-76 10 Watt 220 MHz transceiver. All units will carry full 90 day warranties, and Clegg says they will also supply Hustler, KLM, Phelps-Dodge antennas and KLM amplifiers at group prices. If your club is interested, contact Clegg at 208 Centerville Road, Lancaster PA 17603.

"Repeater DXer chastised by Canadian DOC" was the word at a recent session on the Ohio Area Repeater Council. It seems a formal complaint had been filed with the DOC by the Mansfield OH 34/94 system because of repeated interference to autopatch calls, search and rescue operation and normal QSOs by a Canadian station with a penchant for DXing and the resulting "keying up" of two or more repeaters simultaneously. It is understood that the offending station agreed, upon being contacted by the DOC, to cease and desist the practice. *Reprinted from the Lake Erie Amateur Radio Association* Repeater Newsletter, *October '76.*

Actual text of the Michigan State Law on scanners: "750.508. Any person who shall equip a vehicle with a radio receiving set that will receive

2 METER CRYSTALS

FREQUENCIES IN STOCK

146.01T
6.61R
6.04T
6.64R
6.07T
6.67R
6.10T
6.70R
6.115T
6.715R
6.13T
6.73R
6.145T
6.745R
6.616T
6.76R
6.175T
6.775R
6.19T
6.79R
6.22T
6.82R
6.25T
6.85R
6.28T
6.88R
6.31T
6.91R
6.34T
6.94R
6.37T
6.97R
6.40T
6.46T
6.46R
6.52T
6.52R
6.55T
6.55R
6.58T
6.58R
6.94T
7.60T
7.00R
7.63T
7.03R
7.66T
7.06R
7.69T
7.09R
7.72T
7.12R
7.75T
7.15R
7.78T
7.18R
7.81T
7.21R
7.84T
7.24R
7.87T
7.27R
7.90T
7.30R
7.93T
7.33R
7.96T
7.36R
7.99T
7.39R

FOR THESE RADIOS

Clegg HT-146
Drake TR-22
Drake TR-33 rec only
Drake TR-72
Genave
Heathkit HW-2021 rec only
Heathkit HW-202
Icom/VHF Eng
Ken/Wilson
Lafayette HA-146
Midland 13-505
Regency HR-2
Regency HR-212
Regency HR-2B
Regency HR-312
Regency HR-2MS
S.B.E.
Sonar 1802-3-4, 3601
Standard 146/826
Standard Horizon
Swan FM 2X
Tempo FMH
Trio/Kenwood TR2200
Trio/Kenwood TR7200

Note: If you do not know type of radio, or if your radio is not listed, give fundamental frequency, formula and loading capacitance.

CRYSTALS FOR THE IC-230 SPLITS IN STOCK: 13.851111 MHz; 13.884444 MHz; 13.917778 MHz; HEATHKIT HW2021 600 KHz. OFFSET 11.3 MHz; $6.50 ea.

MASTER GAINER

MODEL GG-144A — Deluxe, Two-Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1¾" O.D. SO-239 coax connector $52.95

GG-144A

STANDARD GAIN MOBILES
Two Meters
- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—50 watts FM

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $28.75

MODEL BBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $26.95

BBLT-144
BBL-144

THF

VHF/UHF ANTENNA—TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. $15.95

HUSTLER "BUCK-BUSTER"
MODEL SF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included) $12.75

SF-2

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58 U cable and connectors attached $14.95

SUPER GAIN MOBILES
Two Meters
- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

CG-144

MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. $26.75

DELUXE MOBILE MOUNTS
For medium length, light weight antennes with ⅜" — 24 base

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached $12.95

TLM

GCM-1

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. $7.50

HUSTLER

UHT-1

VHF/UHF ANTENNA—ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U. $10.15

HF
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signals sent on frequencies assigned by the Federal Communications Commission for Police purposes, or use the same in this state, unless such vehicle is used or owned by a peace officer, or a bona fide amateur radio operator holding a Conditional, General, Advanced or Extra class amateur license issued by the Federal Communications Commission, without first securing a permit to do so from the Commission of the Michigan State Police upon such application as he may prescribe, shall be guilty of a misdemeanor, punishable by imprisonment in the county jail not more than one year or by a fine of not more than $500, or by both such fine and imprisonment in the discretion of the court."

You'll notice that no mention is made of any CB license, commercial license, or Novice or Technician grade license!

Reprinted from The Printed Circuit, *Bulletin of the Great Lakes Repeater Association, October '76.*

AMSAT, the Radio Amateur Satellite Corporation, now has over 2,500 members, according to the organization's annual report. That's a growth rate of 9%. Among the year's accomplishments: Canadian and US use of both OSCAR satellites for experiments in downed aircraft location, FCC authorization of ASCII on the satellites which enabled stations to remotely access a computer in Canada via OSCAR 7, University of Arizona and National Institute of Health researchers' experiments with the relay of electrocardiograms (EEGs) through OSCAR 7, and continued work on a prototype computer for use in onboard spacecraft control, with an eye on AMSAT Phase III. The Phase III spacecraft prototype is progressing with a December 1979 launch date projected. A second project, AMSAT-OSCAR D (A-O-D), is also underway with two transponders under construction. One will be two to ten meters while the other is a four Watt two to 70 cm unit developed by the Japan AMSAT Association (JAMSAT). Launch date for A-O-D is set for June 1977.

The Chicago FM Amateur Radio Club (CFMC) really scored on election day. Club efforts brought two television news stories, after the FMers provided communications for LEAP (Legal Elections in All Precincts) lawyers. WA9LRI reports participation from 30 amateurs who worked from 5 am through 9 pm using 2, 220, and 450 repeaters. CFMC dispatchers staffed LEAP offices, sending attorneys and their amateur communicators to investigate voter complaints throughout the city. Aside from the TV publicity, project LEAP brought radio PR and an article in the *Chicago Daily News.*

There are 15,500 licensed amateurs in Canada, and 1,400 of them have responded to a national poll on DOC proposals to restructure Canadian licensing. At issue is a non-code Experimenter class, and a 5 wpm Novice license. From the Canadian Amateur Radio Federation's poll results, it is apparent Canadian hams don't like the idea of non-code licensing. It was 63% against, 4% in favor, with 16% favoring an above 50 MHz Experimenter class. The idea of Novice licenses drew a much more positive response, with 55% of those questioned supporting it.

Our thanks to VE3CDC for passing along the CARF results.

Members of the Amateur Radio Society of India will soon have a new headquarters. The Indian government recently allotted the society a 4050 square foot tract of land in Delhi for a building and antenna farm. The land will be rented to the Society for a token fee. Members are at work planning the new facilities, which are expected to be operational early in 1977. Donations are being solicited. Contributions may be sent to: Amateur Radio Society of India, P.O. Box 534, New Delhi-1, India.

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New 300/600 Mhz Digital Frequency Counters are in a class by themselves when it comes to reliability, accuracy and performance.

Quality features include full 7 digit display panel with large LED readouts, resolution to .1HZ, high input sensitivity, automatic limit on input, controlled time base, selectable gate times .1 sec., 1 sec. and 10 sec. and high stability time base options available.

Complete Kit includes all parts, drilled and plated PC boards, cabinet, switches, hardware and a complete Instruction Manual including calibration instructions.

SPECIFICATIONS

Input Impedance:	Direct HI-Z, Pre-scaled 50Ω
Sensitivity:	50 mv/20MHZ 150 mv/200MHZ 200 mv/600MHZ
Time Base:	10 Mhz crystal oscillator
Stability:	
Standard	10ppm 25 to 40 C
TCXO*	2ppm 15 to 55 C
Frequency Range:	Model 300 1HZ to 300 Mhz Model 600 1HZ to 600 Mhz
Resolution:	0.1 second gate 1.0 second gate 10.0 second gate*
Power:	120 VAC 25 Watts 12 VDC*
Cabinet Size:	8" x 8" x 2½"

*Optional

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$249.00 Model 600

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A VFO for Sidebanders

- - 5-5.5 MHz

Many transceivers today use some form of frequency synthesis or mixing process to derive a desired output frequency.

The mixing method is a very good one for several reasons, one of which is excellent frequency stability. For example, if an output frequency range of 28.0 to 28.5 MHz is required, it could be obtained by mixing 5 to 5.5 MHz and 33.5 MHz, the latter being furnished by a crystal oscillator. Using this method, the stability of the output frequency will be similar to that of the 5 MHz component, any drift which may occur in the crystal frequency being relatively small.

To derive a stable output frequency it only remains therefore to provide a source of 5 to 5.5 MHz signal which, when set to the required frequency, will continue to maintain that frequency and not be affected by the changing environmental conditions the oscillators may undergo during a communication period.

Reprinted from *Amateur Radio*, the Journal of the Wireless Institute of Australia, October, 1973.

Using this method of frequency production, the vfo can be allowed to run continuously, preferably 24 hours per day.

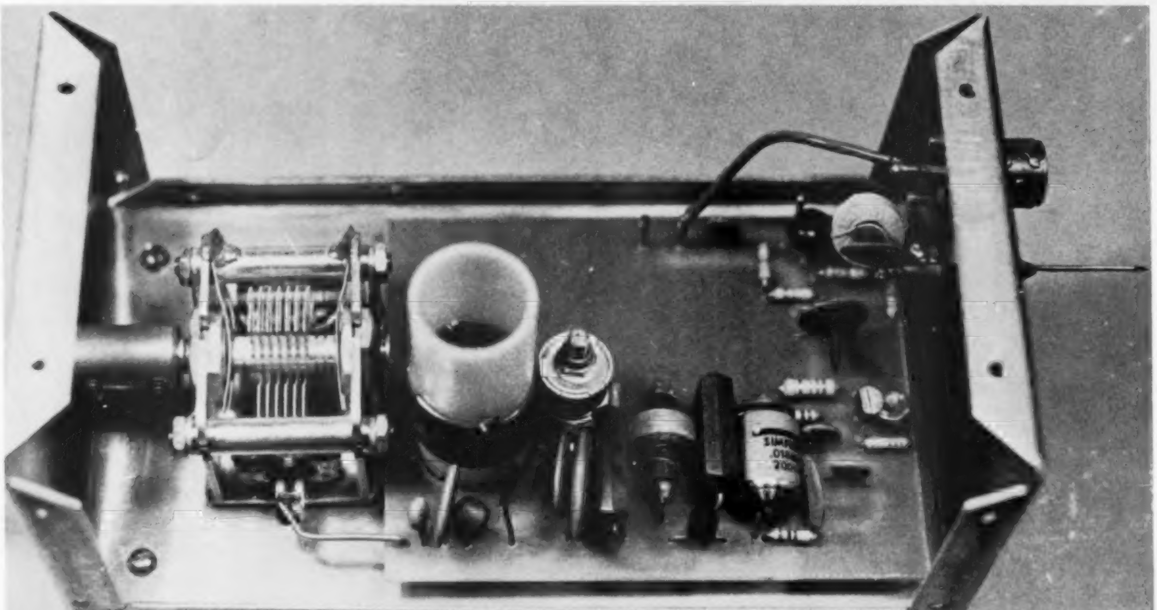
The vfo to be described here will provide such a variable source. Frequency range is 5.0 to 5.530 MHz. Stability is in the order of 2 parts per million per hour after warm-up. The frequency curve can be linearized using the split segments of the capacitor shown. Output voltage is 3 volts peak to peak sine wave into 1000 Ohms. Supply requirement is 12.6 volts at 25 mA. A supply voltage change of plus or minus 1 volt will result in a frequency change of about 1 Hz.

An FET is used as the maintaining device rather than a bi-polar transistor, in the interest of improved stability with changes in temperature.

The components of the oscillator and buffer amplifiers are laid out on an etched fiberglass board measuring 7 x 9 cm. Good mechanical stability can be secured using the form of construction shown, a U-shaped box and cover measuring 15 cm long, 6.5 cm high and 8.5 cm in width.

An ordinary ¼ inch solid coupler is used on the capacitor shaft inside the vfo box and a plastic rod should be used to connect the capacitor with the drive mechanism. A number 3 knitting needle is exactly ¼ inch in diameter.

The entire box is mounted on four 1/8 Whit. screws which are secured to the main exciter chassis through four



rubber grommets which provide some mechanical, electrical and thermal insulation. A considerable improvement in stability can be obtained by enclosing the vfo box in one inch thick polyfoam insulation. The coax from the vfo output socket provides the ground return for the supply.

The capacitors used at C4 and C5 are ceramic N750 type for frequency drift compensation. The values shown were arrived at after some experimentation with temperature versus frequency. It will probably be necessary to find the exact amount of capacitance by similar experiments. If the frequency increases with temperature, there is too much negative capacitance; if the frequency decreases with increasing temperature, there is too little. Use C2 to restore the correct frequency range. Remember to give the components time to reach room temperature after soldering before taking frequency measurements. If a very stable vfo is required, you must be prepared to spend some time in determining the exact amount of capacitance required.

The author spent considerable time experimenting with various types of coil formers and fixed capacitors in the tuned circuit. A good quality ceramic coil former is ideal of course, but here in Melbourne there appears to be no ready supply. The former finally used was a ¾ inch Wynne (teflon).

An output waveform which is distorted may be traced to an FET which has too much gain. As 2N3819s have considerable parameter spread, it may be necessary to try a few FETs in order to obtain a clean output waveform. ■

Parts List

C1 – 50 pF Variable Polar C28/141 or similar
C2 – 25 pF Trimmer C005 BA/25E
C3 – 47 pF Ceramic NPO
C4 – 8.2 pF Ceramic N750
C5 – 3.3 pF Ceramic N750
C6 – 47 pF Ceramic NPO
C7 – 100 pF Ceramic NPO
C8 – 680 pF Silver Mica
C9 – 680 pF Silver Mica
C10 – 15 pF Ceramic NPO
C11 – .018 uF Styroseal
All other capacitors as shown
All resistors 1/8 Watt 5%
L1 – 4.5 uH: 17 turns 18 swg enameled copper on 3/4" Wynne former (start and finish held in place with a small amount of Araldite)
RFC 1 – 2.5 uH Single pie (Aegis)
RFC 2 – 2.5 uH Single pie (Aegis)

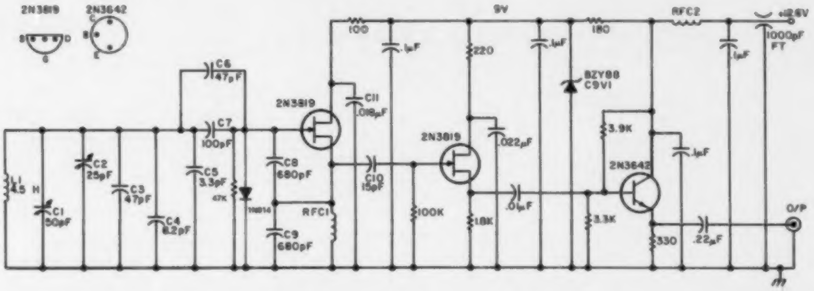


Fig. 1.

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1/77

Gil Boelke W2EUP
505 Main St.
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Practical Solar Cell Power

- - great for remote repeaters

Sometimes you find yourself surprised at what you can do when you think hard about a problem. A good example is energy conservation (a popular subject these days), and techniques developed for WR2ACA.

Most of the time there is no shortage of power because the wind blows often enough and hard enough to provide what is necessary. Nevertheless, there are times when power must be rationed carefully in advance by the design of the equipment. Conditions of energy availability can be divided into three categories:

(1) Abundant wind, generators working, full battery charge.
(2) Average, moderate winds with normal repeater activity. Repeater draws more power than generators deliver, but idle periods allow catch-up.
(3) No wind at all or failure of the charging system for extended periods.

If the first condition persisted all the time, we could install electric heaters in the place and have no problems. Power consumption of the equipment would be of little consequence.

The second condition represents normal operation as we experience it 90% of the time at WR2ACA. Here energy must be budgeted carefully so that idling drain stays low enough to allow recharging of the batteries as rapidly as possible.

Depending on the battery charge level at the start of condition (3), normal operation will continue until the charge is reduced to the minimum required to keep the system "alive" to assure self-recovery at the end of the energy drought (assuming no back-up system or failure of same). In order to provide continuous operation of vital systems (such as the control and intrusion alarm systems), and to make sure there is enough energy to excite the wind generator when the wind does return, the batteries must never be allowed to go completely dead. When you reach this point, it becomes crucial to conserve every mA in the vital systems.

Various pieces of equipment that are used in different time cycles can be considered from different points of view in terms of power drain requirements. For example, if the transmitter is to deliver 50 Watts of output, at least 50 Watts of power must be supplied to it even if it is 100% efficient. For a system voltage of 13 volts and a 50% efficient transmitter (good) that operates for a continuous two hours per day, 15.4 Ampere-hours are consumed per day.

On the other hand, a receiver that draws 100 mA but runs for 24 hours per day consumes 2.4 Ampere-hours over the same period. The receiver draws only 1.3% as much current as the transmitter, but it consumes 15.6% as much energy per day because it runs 12 times as long each day. With this time ratio (or "duty cycle"), a current drain increase of 1 mA in the receiver is equivalent to a 12 mA increase in the transmitter. Thus it is 12 times as important to find a way to conserve current in the receiver as in the transmitter.

If the receiver is only one of several in the system and there is a fair amount of logic drain involved, it is easy to rival the energy requirements of the transmitter in normal operating cycles.

So, we conclude that receiver drain is important. In emergencies, even all but one receiver could be shut off to save current for the systems critical to the recovery of the repeater, but we start to take reliability risks since failure of that receiver alone would cause total loss of remote control capability. But we could take that risk if necessary, saving energy to sustain the other systems: intrusion alarm, wind-generator tachometer, touchtone decoder, logic memory, battery monitors and active measuring equipment.

If we provide for system self-recovery and take the chance, we could even shut off the last receiver. This could be done automatically when the system is on its last legs and you would lose voluntary remote control. The receiver(s) would be automatically reactivated when the voltage came up due to renewed wind or if the intrusion alarm tripped.

That saves the drain of all receivers, but unless you have been careful in the assignment of mA in the design of the vital systems, you might not be able to hang on long enough after such a drastic measure.

So, let's categorize the equipment in terms of current drain and systems role:

(1) High-drain low duty cycle with little chance of improvement (transmitters, loudspeaker amplifiers, remote motor drives, etc.).
(2) Medium-drain circuits that draw current only when the repeater is activated but not transmitting (receivers, transmitter synthesizer circuits, etc.).
(3) Potentially low-drain circuits on vital systems needed for control, protection and self-recovery.

The last category represents the majority of circuits in which a mA here and there rapidly adds up to surprising levels. If the total power drain of all these circuits can

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Reprinted from *The Link*, Bulletin of the Buffalo Amateur Radio Repeater Association, Inc., May, 1975.

be held to a small fraction of the self-discharge current level of the batteries, we have done good work.

Nickel cadmium batteries of the vented type can hold most of their charge after standing for a year, but the batteries we have to work with are of questionable history. It is probably optimistic to expect self-discharge to take longer than 6 months. If that is the case, a 440 Amp-hour bank drains itself at a constant 100 mA. The current capacity is less, but ultimately we would like a capacity of at least 400 A-H.

You can see that the current levels involved are still comparable to the self-discharge rate – hence further effort in conserving current is worthwhile.

In the present WR2ACA repeater, current drain is about 8½ Amperes at full repeat operation, about 500 mA activated but not keyed, and about 120 mA idling. The idling current can be broken down into a 450 MHz receiver drawing about 45 mA, a 2m receiver with preamp at about 55 mA, and about 20 mA for the remaining systems.

It is the idling current that provides the greatest opportunity for improvement; hence in it lies the thrust of this article. It is true that the system as is could be left alone and operate satisfactorily. However, if two or more additional receivers were added to the system, the drain could grow rapidly. Thus, with expansion in mind, our techniques could stand some improvement.

A technique used in the new 2m receiver has solved the problem, at least for the receivers. It is based on a simple idea; turn them off for most of the time!

When the repeater is idling, the receiver serves only one purpose: to detect the presence of a control signal. Suppose we turn the receiver off 9 seconds out of every 10. During the one second it is on, the receiver determines whether or not a signal is present. If one is, the squelch circuit holds the receiver on until such time as the signal again disappears and the squelch closes again. As long as no signal appears, the receiver is on only 10% of the time; hence it draws only 10% of normal drain.

This technique was utilized on the old ACA receivers, but it wasn't effective because the only way to put them in this mode was by remote control. In order to get the system back to normal, it is necessary to hold at least 10 seconds of carrier to make sure you have covered one of the "on" periods, then transmit the correct control codes. A 10 second wait is too long so it wasn't practical to idle the receivers this way for normal operation.

The idea was still attractive anyway because two receivers operating in this way, if normally consuming 100 mA, would only draw 10 mA (or possibly less by using a lower duty cycle).

If you could shorten the "off" time to a tolerable waiting period, it would be necessary to reduce the "on" time by the same proportion to save the same current. The limiting factor boils down to the shortest possible time you can turn the receiver on and reliably detect a signal.

There are many practical pitfalls that must be circumvented to make a receiver turn on rapidly. Assuming that these can be overcome, what are the limiting factors dictated on theoretical grounds?

The answer is easy for the case of a strong signal but somewhat more involved if weak-signal detection is a requirement. For linking receivers it can safely be assumed that the signal is always full quieting since the transmitter location power and signal path is known and fixed.

In this case we only have to have power applied long enough for a signal to propagate from the antenna terminal to the point of detection. Most of this delay is in the i-f filter that determines the receiver's selectivity. FM filters I have measured show delays of 200 to 300 microseconds. If we allow another millisecond for the detector to operate, the "on" time is only 1.3 milliseconds. To save 90% of the power, the receiver can be set to sample every 13 milliseconds! In everyday operation a delay as long as 150 milliseconds is hardly noticeable because it takes many receiver squelch circuits that long to operate; hence, if the sampling period is increased to 130 milliseconds, the receiver current drain is only 1% of its normal value!

The limiting factor in a repeater receiver, as opposed to a linking receiver, depends on how weak a signal you would like to detect. In the noisy signal case, the receiver must be left on for a period of time to make a statistical average of signal power to noise power. This process is called integration.

All weak-signal detection schemes can be boiled down to filtering and integration combinations of one sort or another. Disregarding the filtering aspects for the moment, the sensitivity afforded by an integration system is proportional to the integration time. (There's that nasty word *time* again!) Simply stated, this means that the receiver "on" time must be longer for a weak signal than a strong one, forcing us to choose the "best" compromise between sensitivity, sample interval and the reduction of current. An FM signal having enough noise on it to make copy difficult can be detected in 10 to 20 milliseconds. If we assume the 20 millisecond figure, the receiver can be turned on 5 times per second and still save 90% of its current drain!

After a series of hair-tearing sessions on the ACA receiver, a sensitivity of about 0.1 uV for a reliable squelch break could be achieved. To allow for temperature variations (and Murphy), the squelch setting was tightened to about 0.15 uV. A minimum of 3 samples per second was chosen as a tolerable objective. The result is that the standby drain is reduced from about 45 mA with a preamp to a very desirable 3 mA.

When a signal is received during one of the samples, the squelch breaks and locks the receiver on for the duration of the signal. If the sender subsequently transmits a turn-on code (whistle or touchtone) to activate the repeater, the receiver is locked on for the entire time the repeater stays in the active state. Thus you only have to "wait" for 1/3 second when you turn the repeater on; after that, the receiver becomes as normal as any other 4 channel repeater receiver.

None of this is really new; duty cycling techniques are as old as technology itself. They have been applied in communications to hand-held transceivers with their tiny batteries, an obvious application. But applied to our battery-operated repeater system, it works wonders. If 100 mA of continuous receiver drain was tolerable before, we could accommodate 33 repeater receivers or nearly 300 link receivers (or a mix of the two)!

Of course it is possible to design lower current receivers, too. At the present time this approach would eliminate the integrated circuit limiter discriminators and require more costly transistors. Thus it would increase the number of parts, and certainly increase the difficulty of design.

Pulsing is easier. We could go further – design a low current receiver and *then* pulse it for even greater savings.

Then again, do we really need more than 300 receivers? ■

73 Magazine *Staff*

A Simple RC Substitution Box

-- using a matrix

Those amateurs who are constantly engaged in circuit experimentation or development work have probably purchased or built elaborate R and C substitution boxes. Such substitution boxes greatly simplify the problem of finding just the right component value to use to optimize circuit performance for any desired condition (maximum gain, bandwidth, stability, etc.). For those amateurs who just occasionally build some accessory circuits, substitution boxes would also be very useful when a given circuit doesn't work exactly as it should or when one wants to determine if an available component will do in place of a specified value. Unfortunately, cheap RC substitution boxes don't buy you too much. The increments in which they cover RC values are usually too large and calibration can be poor. One can substitute potentiometers for fixed resistors in a circuit, but their calibration is poor and one has to constantly check the value of a setting with an ohmmeter. The result of all this is that most occasional circuit builders end up soldering in components of a fixed value into a circuit and by trial and error arrive at a successful result or a hopeless jungle of tack-soldered components.

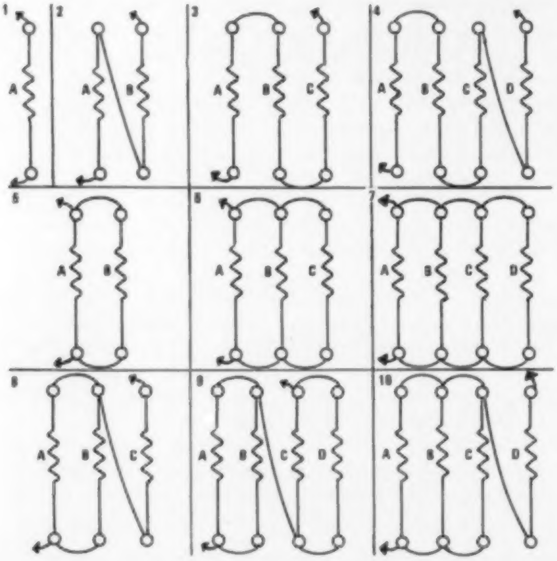

Fig. 1. Interconnection diagrams for four resistors in substitution matrix.

The simple matrix described in this article can solve those problems for the occasional circuit builder at a very low cost and still achieve accurate results.

Most RC substitution boxes, whether they be for resistance or capacitance substitution, make use of switches to select components of various values. However, another approach would be to take a fixed number of components (R or C) of different values and hook them up in as many ways as possible (series, parallel, series/parallel, etc.) to obtain a succession of different overall values. However, how many fixed values should be chosen to keep the circuit complexity within bounds, and what should their individual values be both to obtain a good overall substitution range and have a smooth progression of resultant substitution values?

We'll let a computer solve some of the latter questions, and it's not surprising that a computer comes up with a "binary" type answer. We'll use resistors to demonstrate the idea, but it is equally applicable to capacitors, as explained later. Take four components (resistors) of value 10, 20, 40 and 80 Ohms and let's see how many different ways they can be interconnected. The interconnection possibilities are illustrated in Fig. 1, starting with the simple use of one of the resistors alone and then various series and series/parallel connections. There is nothing new about these circuits, but what is interesting is what happens if one tries all the circuit possibilities and then arranges the resultant values that can be achieved in order. The result, as shown in Table 1, is a wide, smooth range of resultant values going from 5 Ohms to 150 Ohms. Four *properly* chosen resistors have resulted in the equivalent of almost 40 different resistor values progressing in very even steps over a 30 to 1 range!

Table 1 is, in fact, a universal value table. It shows resistance values of 5 to 150 Ohms being achieved by four individual resistors of 10, 20, 40 and 80 Ohms. But, it can be scaled up or down to achieve different ranges with other, similarly ordered values of individual resistors. For instance, the following would be the range of values achievable with the resistors shown:

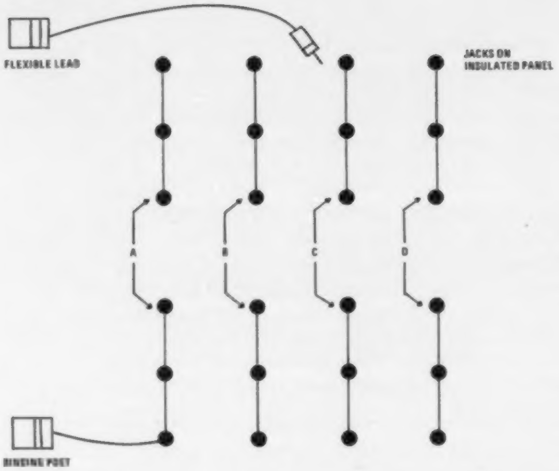

Fig. 2. Matrix panel suitable for either resistor or capacitor usage.

Ohms	Circuit	A	B	C	D
5	7	10	20	40	80
5.6	6	10	20	40	
6.2	6	10	20	80	
6.8	5	10	20		
7.5	6	10	40	80	
8.0	5	10	40		
9.0	5	10	80		
10	1	10			
11	6	20	40	80	
13	5	20	40		
16	5	20	80		
20	1	20			
22	9	10	80	20	40
24	9	10	40	20	80
26	8	20	80	10	
27	5	40	80		
28	8	10	40	20	
29	8	10	80	20	
30	2	10	20		
33	9	10	20	40	80
36	8	40	80	10	
40	1	40			
45	10	10	20	80	40
46	8	40	80	20	
48	8	10	20	40	
50	2	10	40		
56	8	20	80	40	
60	2	20	40		
70	3	10	20	40	
80	1	80			
90	2	10	80		
91	8	20	40	80	
100	2	20	80		
110	3	10	20	80	
120	2	40	80		
130	3	10	40	80	
140	3	20	40	80	
150	4	10	20	40	80

Table 1. Circuit numbers refer to those shown in Fig. 1.

0.5 to 15 Ohms – use 1, 2, 4 and 8 Ohm resistors. 50 to 1500 Ohms – use 100, 200, 400 and 800 Ohm resistors. 0.5k to 15k Ohms – use 1k, 2k, 4k and 8k Ohm resistors. 15k to 150k Ohm – use 10k, 20k, 40k and 80k Ohm resistors. 150k to 1.5 M Ohm – use 100k, 200k, 400k and 800k Ohm resistors.

The resultant values can be checked by anyone using the usual series/parallel resistor formulas for any of the circuits shown in Fig. 1. A more practical question might be how to implement the idea in a simple, reliable form. One could, of course, devise a special switch to achieve all the hookups shown in Fig. 1. Some manufacturers capitalized on this idea. However, a simple home brew way to arrange the four resistors in any of the circuits shown in Fig. 1 is to use a simple plug and jack switch matrix as shown in Fig. 2.

Four columns of six plugs each are used with the individual resistors inserted in the positions shown. The lower "output" terminal is fixed at the bottom of the "A" column. The upper "output" terminal is connected via a flexible wire so it can reach any of the plugs on the upper row of the field. By moving the latter jack wire, plus the use of a few jumper wires between columns, any of the circuits of Fig. 1 can be wired. With a little practice, one quickly develops a system to go from one circuit configuration to the next.

The matrix of Fig. 2 can be built on any insulating material (perforated board stock or plexiglass), using inexpensive non-insulated plugs and jacks. One could permanently solder in the resistors, but if they are made "plug-in," the same matrix can be used for different resistance ranges by plugging in different sets of four resistors. The matrix board is a neat and orderly way of interconnecting the four resistors. But if one had to do it, they could also be interconnected using simple jumper leads by keeping Fig. 1 and Table 1 handy for reference.

Standard value resistors do not come in all the desired values (4k and 8k, for instance). Choose the closest available values to those shown (3.9 and 8.2k, for instance), but measure them once with a good ohmmeter. Usually resistance values, unlike capacitor values, are well within the manufacturers' stated tolerance. Standard, inexpensive 10% tolerance resistors should work fine for most circuit work. But, again, check them first before relying upon them. The tolerances can either build up or cancel out in the various series/parallel circuits. The power rating of the resistors used depends upon the circuit applications intended. For most low level transistor circuits, 1 or 2 Watt resistors will certainly suffice. If one obtains the four resistors for the 0.5 to 15 Ohm range, they should be of the 10 Watt size since they will most likely be used for power supply or audio power amplifier circuit applications.

What about using the matrix for capacitor substitution? Of course, series and parallel resistor circuits have their equivalent in parallel and series capacitor circuits. The circuits of Fig. 1 and Table 1 can be used if one remembers the equivalent circuits. For instance, for 150 Ohms Table 1 calls for the use of circuit 4 in Fig. 1, which is all resistors in series. If one wanted 150 pF (using individual capacitors of 10, 20, 40 and 80 pF), the equivalent capacitor circuit is used – connect all capacitors in parallel. For 5 Ohms, Table 1 uses circuit 7 and connects all resistors in parallel. For 5 pF, connect all capacitors in series. For 30 Ohms, Table 1 uses circuit 9 or AB parallel in series with CD parallel. For 30 pF, use AB in series and then parallel with CD in series. Table 1 can be scaled up or down for capacitors the same as it can be for resistors. The total range for each set of four capacitors will remain a 30 to 1 range: 5 to 150 pF for fixed capacitors of 10, 20, 40 and 80 pF, 0.1 to 3 uF for fixed capacitors of 0.2, 0.4, 0.8 and 1.6 uF, etc.

Unfortunately, capacitors, and especially electrolytic types, vary widely from their marked value. Tolerances of up to -20 and +40 percent for electrolytics are common. One can build a substitution matrix using disc ceramic or mylar capacitors and rely upon the capacitor values to be close enough to their nominal values for general substitution work. In practice, this means a substitution matrix going up to about 1 uF maximum. Beyond this value, when one has to use electrolytic capacitors to build the substitution matrix, it is imperative that the actual capacitor values be measured if the substitution matrix is to have any reasonable accuracy.

This article has described a simple individual R or C substitution matrix. If the resistors and/or capacitor sets are made for plug-in use, the matrix of Fig. 2 can be used for either type of substitution as required by an individual circuit. With a few matrix boards and several sets of resistor and capacitor plug-in sets, a handful of components can be used to replace *several hundred* for substitution, testing and experimental purposes.

Finally, how about RC combinations such as time constant circuits, low pass and high pass filters? These can also be built for various values and frequencies by combining R and C elements on one or more matrix boards. The variety of values here is so broad that it is impossible to define any table for them. However, by using the known R and C values for the individual RC substitution boards and standard formulas, one can easily develop a duplicatable set of response configurations usable for a wide variety of circuit experimentation. ■

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The Compactron Audio Driver

- - three tubes in one

Although transistors are definitely taking over in many areas of electronics, there is still a place in tube-type equipment of modern design for compactrons. The compactron I used in a recently constructed modulator was the 6K11-6Q11. This is a triple-triode, which has two sections that are equivalent to a 12AX7. The remaining section is very similar to a 6C4. So by merely "lifting" the values from the *Radio Amateur's Handbook* or other such source, we can build the complete audio preamp-driver in a single envelope. Fig. 1 shows the schematic I used. I fed a pair of 6L6s, but any pair of pentodes in AB1 up to 6146s could be driven.

Because of the very high gain in such a small area, more than normal care with such things as lead dress must be used to avoid feedback that might lead to oscillation. I found it necessary to include an rf filter at the microphone input, and I shielded the filter with a 35 mm film can. This prevents rf on the microphone cable from getting back into the amplifier.

This audio section would go quite well with K1CLL's rig described in *73*, June 1966, page 18. ■

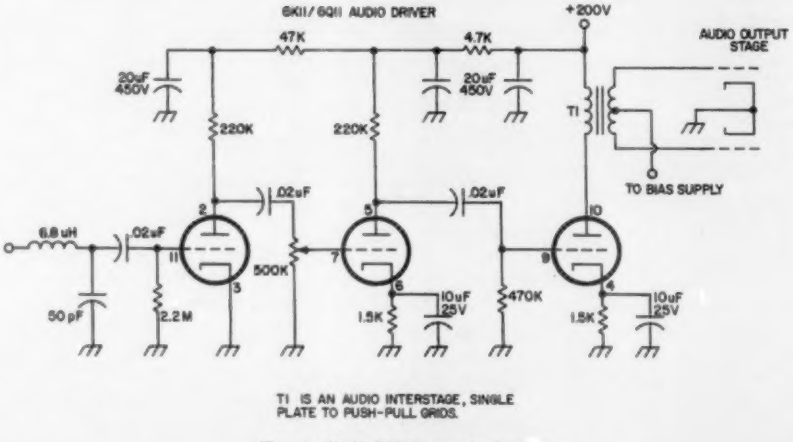

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Fig. 1. 6K11/6Q11 audio driver.

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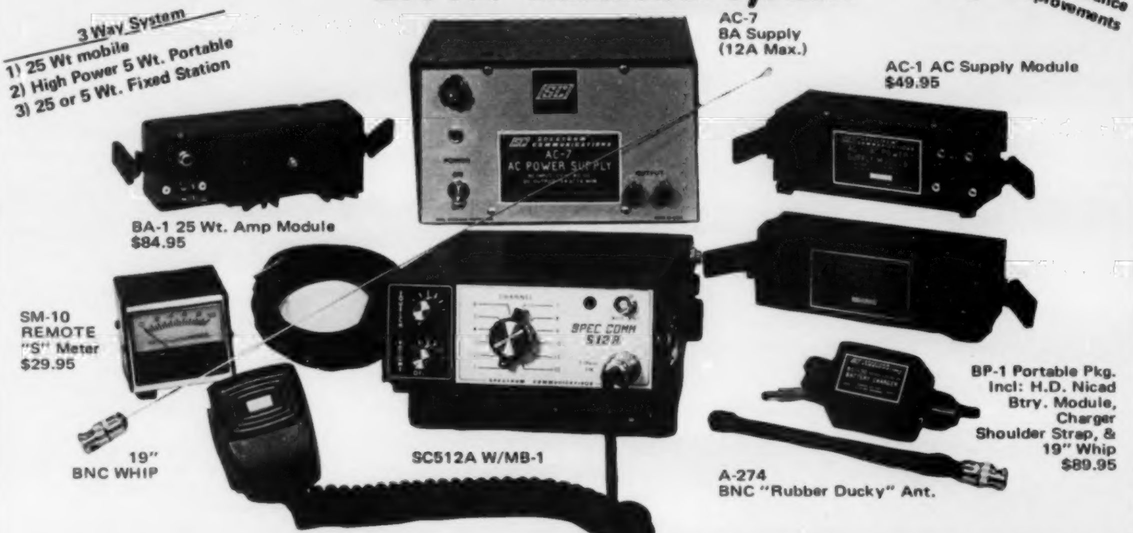
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Social Events

WAUKESHA WI
JAN 22

The 5th annual Midwinter Swapfest of the West Allis Radio Amateur Club will be Saturday, January 22, 1977 starting at 8 am at the Waukesha County Expo Center. Tickets: $1.50 advanced, $2.00 at door. Reserved tables by advanced reservation only – $1.50 per 4 ft. table. Non-reserved tables first come, first served. Talk-in on 146.52 MHz. Directions: I-94 to Waukesha Co. F, south to FT, west to Expo. For information and tickets write: WARAC, P.O. Box 1072, Milwaukee WI 53201.

FORT WAYNE IN
JAN 23

The annual Fort Wayne Winter Hamfest will be held at Shiloh Hall north of Fort Wayne, Indiana on January 23, 1977. Hours are from 9 pm to 4 pm local time, and early parking is available. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC-ARTS). Admission is $1.50 by advanced ticket, or $2.00 at the door. Table space is available for vendors at $1.00 per half-table (about four feet). For more information or advanced tickets and table reservations (held until 9:30 am), write to Hamfest Chairman, AC-ARTS, Inc., P.O. Box 342, Fort Wayne, Indiana 46801.

CORPUS CHRISTI TX
FEB 4-6

The Texas VHF-FM Society will hold its winter meeting at the Holiday Inn, Emrald Beach, 1102 S. Shoreline, Corpus Christi, Texas, on February 4, 5, 6, 1977. For further information contact: James Linthacum W5LCN, 1802 Daly, Corpus Christi, Texas 78412.

MANSFIELD OH
FEB 6

The Mansfield Ohio Mid Winter Hamfest Auction will be held February 6, 1977 at the Richland County Fairgrounds, Mansfield, Ohio. Prizes, flea market, auction – large heated building. Doors open 8 am. Talk-in 146.34/.94 and .52/.52. Tickets $1.50 in advance, $2.00 at the door. Contact Harry Frierhen K8JPF, 120 Homewood, Mansfield, Ohio 44906 or phone (419) 529-2801 or (419) 524-1441.

TRAVERSE CITY MI
FEB 12

The Cherryland Amateur Radio Club will hold its 4th annual Swap 'n Shop Saturday, February 12, from 9 am to 4 pm at the Northwestern Michigan College in Traverse City. A donation of $1 will include a chance on all prizes. There will be plenty of free display tables for whatever you may wish to bring in electronic equipment and parts. Everyone is welcome and a turnout of over 300 hams and experimenters is expected from all over Michigan. For more information please contact Bill Mader WA8WWM, at (616) 326-6392 or Box 2, Empire AFS, Michigan 49630.

WHEATON IL
FEB 13

The Wheaton Community Radio Amateurs will hold their 15th Annual Midwinter Swap & Shop on Sunday, February 13, 1977, from 8 am to 5 pm, at the DuPage County Fairgrounds on Manchester Road (near County Farm Road) on the west side of Wheaton, Illinois. Some tables will be provided, but bring your own if possible. WCRA invites anyone with an interest in buying or selling new or used electronic equipment to attend this hamfest, which will be inside large, heated buildings at the fairgrounds. Advance tickets (available until February 1) are $1.50, and tickets at the door are $2.00. Write Oran Hiscox WB9JJL, Ticket Chairman, Wheaton Community Radio Amateurs, P.O. Box QSL, Wheaton IL 60187. Commercial exhibitors should write Paul Sexauer W9JTO, at the same address.

GRIFFITH IN
FEB 19

The Lake County Amateur Radio Club's 24th annual banquet is Saturday, February 19 at 6 pm, at the Griffith Knights of Columbus Hall, 1400 South Broad Street, Griffith, Indiana. All the delicious home-cooked food you can eat, wine fountain, entertainment, guest speakers, special awards, door prizes, cash raffles and a dance band after. Tickets are $7.50 each: no door purchase. Write (prior to Feb. 3) to Herbert S. Brier W9AD (W9EGQ), 409 S. 14th Street, Chesterton IN 46304.

VIENNA VA
FEB 20

The Vienna Wireless Society annual Winterfest will be held at the Vienna Community Center. Indoor tables, sales, technical sessions, prizes and food. 8 am to 5 pm. Drawing at 3:30 pm. Admission is $3.00; tables $5.00. Information write Box 418, Vienna VA 22180.

NORWOOD MA
FEB 25

The Norwood Amateur Radio Club will be holding its annual auction on Friday evening at 7:30 pm on February 25, 1977 at the Norwood (Mass.) V.F.W. Post on Dean Street, Norwood. This is just off U.S. Route 1 south.

DAVENPORT IA
FEB 27

The annual Davenport Radio Amateur Club Hamfest will be held Sunday, February 27, 1977 at the Masonic Temple in Davenport, Iowa. Admission is $1.50 advance – $2.00 at the door. Talk-in on 28/88 and 52. Refreshments and tables are available. For info and tickets send SASE to Dick Lane WA0GXC, 116 Park Avenue, So. Eldridge IA 52748.

LAPORTE IN
FEB 27

The LaPorte, Indiana ARC will hold its Winter Hamfest on the 27th of February, 1977, beginning at 8 am (Chicago time) at the LaPorte Civic Auditorium. Good food, plenty of free tables, 50 miles east of Chicago. Talk-in on 01-61 and 94, donation $2 at the gate. Information from LPARC, PO Box 30, LaPorte IN 46350.

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Repeater Update

73 will soon be publishing updates to our *Repeater Atlas.* All repeater owners are urged to contact us if their systems have changed from the original listings, or if they have put new machines on the air. Our listings are being computerized, which will make it a piece of cake to keep you informed about the repeater situation. But we can't do it without your help, so get cracking!

Please return completed questionnaire to:

REPEATER ATLAS 73 Inc., Peterborough, New Hampshire 03458

☐ I don't even have a repeater going.
☐ Repeater is private, don't list it.
☐ Repeater is private, list for reference only.
☐ Repeater is open (at least to transients).

Repeater Call ____________ Trustee ____________________ Sponsor ________________________

Location ____ State ____________

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________	__________	__________	L A R
________	__________	__________	L A R

(Circle one; L is local for up to 15 mile mobile range, A is for up to 35 miles, R is for over 35 miles mobile coverage @15 WERP.)

Autopatch ? open ____________ private __________

Notes:

Ham Help

After subscribing to *73* for 6 months, I must say I am impressed with the content of this magazine. As a computer programming student, I find your I/O section very profitable. I need some help in getting my Canadian Amateur Radio Certificate, in the technical areas. Also, anybody in the area with RTTY equipment for sale, please contact

Robert S. Reid
1573 West 65th Ave.
Vancouver, BC V6P 2P9
(604) 263-3620

I have built the "accu-memory" authored by J. M. Garrett WB4VVF described in the August, 1975, issue of *QST*. I also have a "Hal MKB-1" Morse keyboard. For some time while operating one or the other of these two fine units, I have thought how convenient it would be to combine the two pieces of equipment. My problem is how to load the "accu-memory" with the keyboard and how to use it as a buffer to store and release the code on command or automatically. Maybe some of our more knowledgeable readers would be able to help.

Bob Fream WB8OHP
22238 Long
Dearborn MI 48124

I'm willing to help any non-ham who lives in my area get his ticket.

Ed Sieb VE2BAQ
PO Box 296
Cote St Luc, PQ H4V2Y4

We need help. Our recently started Amateur Radio Club at our high school desperately needs equipment. We are doing our best to make money, but we're not making enough. Any cheap or free working equipment would be appreciated. Write us a letter and tell us what you've got.

Michael Harrison WB0NFZ, Pres.
Central High School ARC
116 College Ave.
Flat River MO 63601

Classes, Novice and General, will be offered at Upper Moreland Adult Evening School beginning in January. For the area of North Philadelphia, Willow Grove, Hatboro and Warminster PA, call K3JJO, 643-7300.

W. H. Newell
Box 224
Ft. Washington PA 19034

Anyone in ham land have any manuals on the Heath DX100 or the DX100B? I'd like to borrow or buy.

SSGT Howard H. Ragan
K7ATU/DA4AU
1141-2 USAF SAS
APO NY 09189

I need ham help with theory!

Jerry Otto
5901 Count Turf
Louisville KY 40272
502-937-4384

I have an old Dumont transicom VHF FM unit that was taken out of service at the Fairborn OH Fire Dept. It was given to me by a friend who works there. The model (FCC type #) is 5814-D, Serial #140, and the chassis # is 158030. This is the number I got off the back end of the chassis. The problem: I can't seem to locate a schematic or any other information on the unit. I want to be able to convert it to the 144-148 MHz band. So, could anyone in the country please help me in locating a schematic and other info on the Dumont unit? Any help would be appreciated and I'm willing to pay for the help!

Larry Lawhorn WA4MJQ
1706 Brentwood Rd.
Richmond VA 23222

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The Junk Box as an Art Form

-- new use for blown capacitors

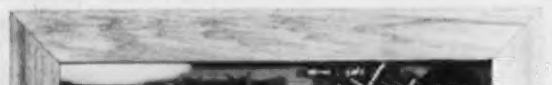
How would you like to have an attractive station decoration and at the same time preserve your antique parts? Well, it's possible by building a shadow box as shown in the photograph.

Over the years one finds that his storehouse of antique parts gradually disappears through loss and breakage. Putting them on a shelf is a real dust catcher, and, in addition, you just don't have the room; besides, a mess of old parts is not attractive.

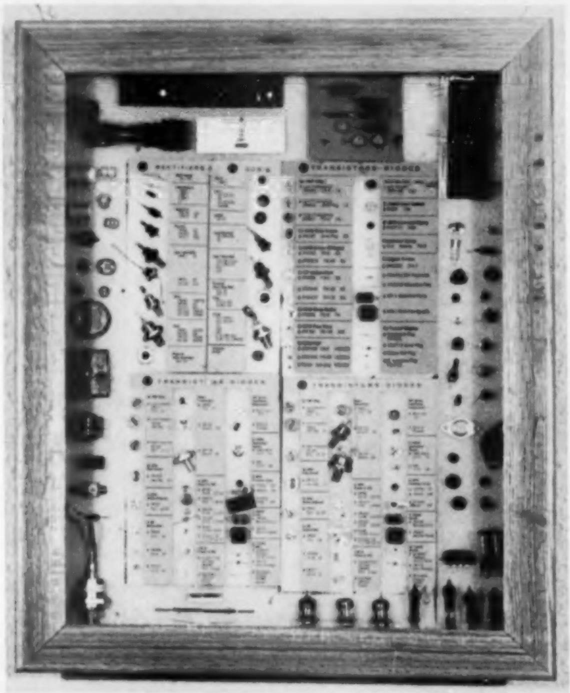
Some of the rare gems in this box are wireless specialty condensers, a Faradon, old dials, a rheostat, an old tube box with the tube removed and mounted next to the box, old variable condensers, a crystal detector, a Thordarson audio transformer, and many others. Your junk box is a gold mine.

Select the parts you want to preserve and then try different arrangements. When you have the arrangement you want, measure the width, height and depth you will need and make your box to size.

You can buy the material, the frame, felt, etc., at the local discount store. Use standard sizes of frames. You will find the natural oak frames are best, but others



Shadow box with antique components.



A companion piece that shows circuit boards, integrated circuits, transistors, and the history of miniaturization.

lend themselves quite well. The total cost of my whole project was $2.75 plus about three hours of interesting labor.

Select frames that have about a ¼" lip on the back so that you can set the shadow box over them and then screw it to the frame. Be sure to apply glue to the glass, as the objective is to make the whole box dust and airproof so the parts will be good for life. Seal the edges to the frame after you have screwed the box to the frame.

The frames I used were 14" x 21" and were just right for these parts. Make the shadow box out of ¼ inch plywood as it is easy to work with and does not split when you nail at the edges. Before you nail, apply a small amount of glue on the edges. Make the sides first and square them up and let set overnight. Then lay on a piece of plywood and mark the back and saw. Then apply glue and nail. Now paint the box inside and out, and after it's dry, glue a piece of red or green felt to the inside – bottom only.

There is not a set procedure for mounting – you will have to improvise as you go. Most all of these parts were mounted with small screws. Some components mounted easily after soldering on small lips, etc. Very lightweight brass sheet was used for clamps, etc. The ¼" plywood gives you plenty of bite to mount any medium sized part. Be sure that the screws don't go through the back and scratch up your wall or table.

This makes a wonderful decoration for the wall of your ham shack – just put screw eyes in the top at each edge and hang it on the wall. This same idea lends itself to a lot of things around the ham shack and perhaps you can even make the XYL happy by making her a shadow box for memorabilia she might like to display. ■

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The Mod Squad Goes 220

-- pub serv receiver for pocket 220

C. Warren Andreasen WA6JMM
P.O. Box 8306
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There is the slogan "use it or lose it," which we have all heard in connection with the 220 MHz amateur band.

Here in Southern California, I took this to heart and, lo and behold, that band is in my opinion the best band of all! That band now has more activity and more repeaters than 2 meters does in some parts of the country, with many hundred users in the Los Angeles area alone.

The one problem we have is the lack of available equipment. So far only one hand-held transceiver has come out for this band and, as of this writing, it is not yet being delivered. We have need for something small, light and not too expensive. What I (with the help of proddings and suggestions of Bill Duhaime WA6NTW) have developed is a sensitive 12 channel (that's correct – *12 channel*) pocket receiver that is an ideal back-up receiver, duplex receiver, and in my case, the remote end of an auto burglar alarm system.

This receiver is a converted MR-2 receiver (Photos 1 and 2). It was designed to cover up to 170 MHz, has built-in nicad batteries, comes complete with charger and is available for about $80 from several sources, including me. When conversion is complete, the receiver has a sensitivity of better than .5 microvolt, and is free from intermod and image problems. The receiver has three filters incorporated in its design, with two in the 10.7 MHz i-f and one in the 455 kHz i-f, and is, in sort, a darn good receiver. It has 20 transistors, including five stages of limiting and a very fast squelch which gives no squelch tail to speak of.

Photos by Herbert Dick

The Conversion

The first step of the conversion is to modify the local oscillator multiplier. The crystal oscillator stays the same, as the crystal will be in range of the normal tuning of oscillator coil T8. Referring to Fig. 1, and the diagram supplied with the radio,

Photo 1.

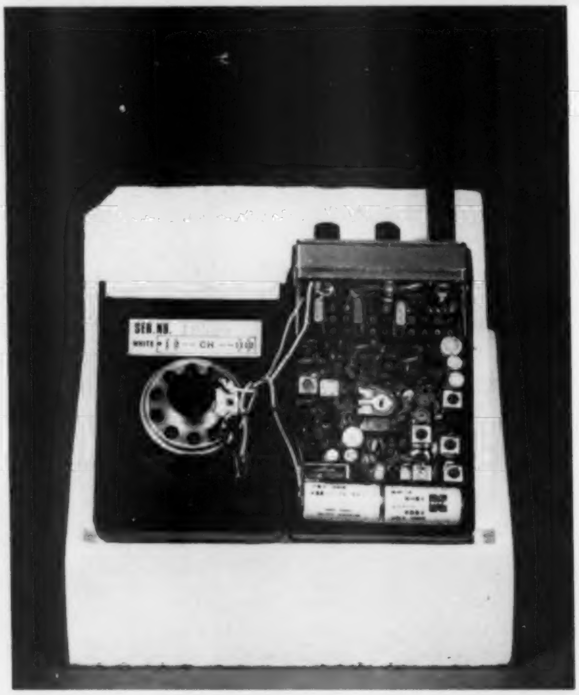


Photo 2.

locate C2. This capacitor is OK as is, but if you wish to use the crystal from a Midland 13-509 receiver, as I did, this capacitor may be removed, making the crystals interchangeable. T8 will now tune with the slug near the top of the coil form. The crystal frequency will be the same as the Midland 13-509, which is the desired 220 Mhz frequency minus 10.7 MHz, divided by 4 (3rd overtone series resonance into 20 pF load capacitance). The next step is to modify T4. This stage is made to quadruple by replacing the 7 pF capacitor (C28) with a 5 pF capacitor and removing one turn from the secondary of the coil.

The method of modifying this, and all following coils, is as follows: Remove solder from can tabs and *carefully* work the can off coil. Be very careful since the coil form will break easily if forced (see Photo 3). As the can pulls clear, note the ferrite cup that will probably stay in the can. Do not lose or break this as it is an important part of the coil. After placing can and cup aside, remove solder from all five pins of the coil form and gently remove this form from the PC board. Next place coil in a soft-jawed vise and gently hold in place (Photo 4). Locate the secondary winding (the three pin side) and using a needle and small soldering iron, gently lift the wire from left end pin (bottom view with 3 pin side facing you). Carefully remove one turn and reconnect wire after removing insulating varnish. Reassemble the coil form by installing back on PC board in the reverse order as removed. This coil will now tune to the 212 MHz range needed and the receiver will now hear a strong 220 MHz signal if one is provided.

The next step is to modify the input tuned circuit by replacing the 7 pF capacitor (C4) with a 3 pF, C1 with a 10 pF capacitor and remove one turn from the secondary winding of T1. This winding is lifted from the same pin as it was in the local oscillator multiplier. Next, the output circuit of this same stage (rf Amp) must be changed. Remove the same one turn from secondary as in the other two coils and replace the 7 pF capacitor (C6) with a 5 pF capacitor. Now go to the mixer input coil (T3) and in a like manner remove one turn from its primary and replace its 7 pF tuning capacitor (C8) with a 5 pF capacitor. The conversion is now complete with the exception of tuning.

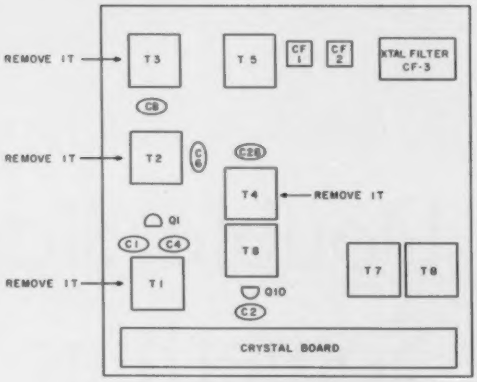


Fig. 1.

Tuning

Place a crystal in a position and select it with the channel switch. With a strong signal source and an attenuator (rotatable beam and distant transmitter), tune the oscillator and multiplier coils for maximum received signal. The tuning of the multiplier is quite critical and should be done with care for maximum sensitivity. Note: The slugs are very brittle and a proper fitting tuning tool (even if home brew) must be used or the slug *will* break. Always attenuate signal until noise is heard and tune for maximum quieting. Following the same procedure, likewise tune antenna coil T1, amplifier output coil T2, and mixer input coil T3. If all is working properly, the MR2 will now work better on the 220 MHz band then many popular rigs work on two meters. I should mention that this receiver works very well on two meters, before the conversion, and is a very good buy for that purpose alone. ■

Photo 3.

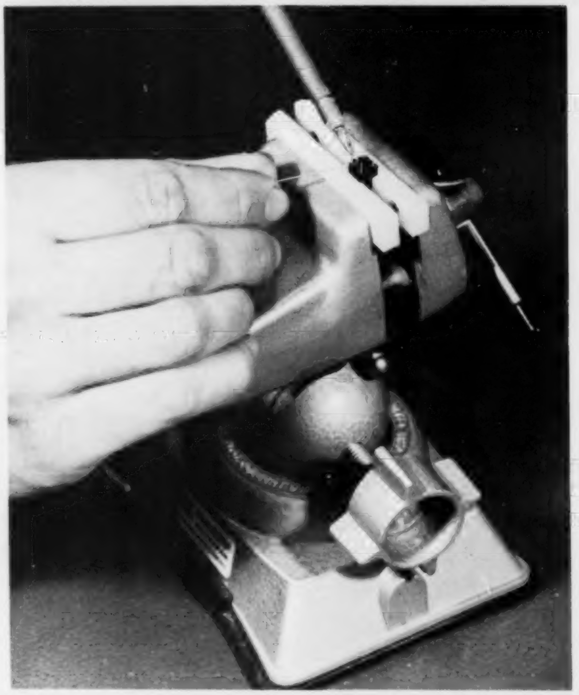


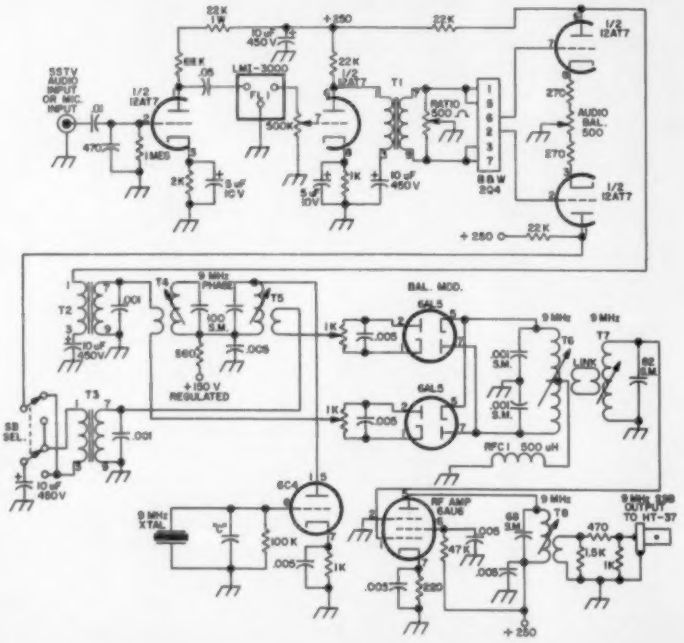
Photo 4.

Louis I. Hutton K7YZZ
12235 SE 62nd St.
Bellevue WA 98006

Double Sideband: Something New?

- - one for voice, one for SSTV

One of the modes of operation permitted by the FCC for SSTV is the operation on ISB (Independent Sideband). In this mode of operation the voice signals are transmitted on one sideband while at the same time the associated SSTV signal is transmitted on the other sideband. At the present time there are no commercial amateur radio transmitters on the market that have this mode of emission available. Several amateurs have been active on ISB using circuits they have developed for SSB transmitters that use the filter method of sideband generation as described in the SSTV Handbook.[1] My transmitter is a Hallicrafters HT-37 which generates its SSB signal by the phasing method of sideband generation. I decided to try and see if I could figure out a way to get ISB from my HT-37 for my SSTV transmissions. This article presents the results of this effort and shows how I was able to generate ISB from the HT-37 by using an external unit and a very minor modification to the HT-37 transmitter.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270
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1/2 12AT7
+250
22K
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10 uF 450V
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100 S.M.
T5
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6AL5
1K
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6AL5
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9 MHz
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.001 S.M.
.001 S.M.
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10 uF 450V
6C4
9 MHz XTAL
"C"
100K
.005
1K
RF AMP 6AU6
47K
.005
.005
220
68 S.M.
9 MHz
T8
.005
470
1.5K
1K
9 MHz SSB OUTPUT TO HT-37
+250

Fig. 1. ISB exciter for HT-37. T1, T2, T3 = Lionel #GH1203-2-H 22k to 600Ω. FL1 = UTC LMI-3000 low pass filter.

The phasing method of sideband generation was first used when SSB appeared in the ham bands. A well-known circuit that has been used by many builders of SSB gear was presented in the G.E. Ham News[2] back in 1950. That circuit was used to develop the SSB transmitter made from the old Command transmitters[3],[4] and forms the guidelines for the ISB unit in this article. I first considered just making another exciter like the one in the HT-37, but the unavailability of the proper components led me back to the old standard phasing circuit design used many years ago.

In this ISB system the HT-37 is used to generate one of the two sidebands and an external exciter is used to generate the other sideband. The output of the external unit is fed to the same mixer as that used in the HT-37 SSB generator. Due to the method of heterodyning in the HT-37 to obtain the proper sideband for that particular frequency, it is necessary to manually select the desired complementary sideband when using the external ISB exciter. The particular SSB used for each band is identified from a chart on the front panel of the ISB exciter. The design and operation of phasing type SSB exciters are very well described in the referenced articles and will not be reviewed in this article.

Construction

The unit shown in the photographs was constructed on two separate chassis, one stacked on top of the other. The overall size of the finished exciter is 3½" wide by 7½" high by 12" deep. It is housed in a surplus aircraft equipment cabinet. The top chassis contains all the electronics, and the bottom chassis has the power supply. The power cord and the output connector are at the rear. The front panel contains

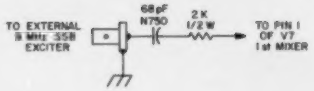


Fig. 2. HT-37 modification.

the audio input connector and gain control, the sideband selector switch, power switch and pilot light. I used a commercial low pass audio filter in the speech amplifier section to limit the upper frequency response to 3 kHz. This filter may be deleted and a filter using TV width coils substituted as shown in the referenced articles. I had an LMI-3000 unit in my junk box, so that is what I used. The other filter will work equally well in this circuit. T1-T3 are surplus Lionel audio transformers of the type used in the reference 3 article. A good substitute would be the Lafayette AR-151. T4 and T5 were made from surplus SCR-522 coil forms. They are 3/8" diameter and have 12 turns of number 20 wire with a three turn link at the cold end. They are padded with a silver mica capacitor to resonate at 9 MHz with the slug about halfway in the coil. T6 is a slug-tuned coil of 5/16" diameter with 8 turns, center-tapped. The link is two turns wound around the center of the coil. The wire on T6 is also number 20 enameled. The link wire is made from single strand plastic insulated number 20 enameled. The T7 and T8 are small ¼" diameter coil forms, slug-tuned and wound with 20 turns of number 30 enameled wire. The link is three turns on the cold end. The coil is padded with silver mica condensers to resonate at 9 MHz with the slug at midrange.

The power supply should provide 250 volts at 90 mA and a regulated 150 volt output at 10 mA. The 80 mF of filtering seems to be sufficient for this unit to provide good dc to the audio and rf circuits.

The modifications to the HT-37 were surprisingly simple. The schematic diagram of the HT-37 shows that the output of the internal 9 MHz exciter is fed to a mixer V7. I decided to feed my external exciter into that same mixer grid. A hole was drilled in the front panel midway between the driver tune knob and the band selector knob. A type BNC connector was installed in this hole. The 68 pF capacitor and the 2k resistor are then wired from this connector to pin 1 of V7. You will find that locating the connector at this position on the front panel of the HT-37 makes for very short leads from the connector to the tube socket. This is the only modification required to the HT-37.

For proper operation of the ISB system, the 9 MHz oscillator in the external exciter must be zero beat with the 9 MHz oscillator in the HT-37 exciter. I accomplished this by monitoring the output of the HT-37 9 MHz signal via the newly installed BNC connector on the transmitter front panel, on a communications receiver (Hammarlund Super Pro, 1945 vintage). The output from the external 9 MHz oscillator was also picked up by the receiver and the detected beat note observed. A padding capacitor was installed across the crystal to pull it down to zero beat with the HT-37 exciter oscillator. The external 9 MHz oscillator was initially several hundred Hz higher than the HT-37 9 MHz oscillator. These two oscillators must be zero beat to assure that the recovered sideband will contain the proper frequency information. If they are not zero beat, and the receiver is tuned so that the picture information has the correct frequency information, then the accompanying voice will not have the proper sound. The adjustment of the 9 MHz ISB exciter is just like any other phasing type SSB exciter and is fully described in detail in reference 4; therefore it will not be repeated here.

HT-37 ISB EXCITER
AUDIO GAIN
SSTV INPUT
SIDE BAND
SELECTOR
K7YZZ
SSTV
POWER
ON

Operation

The output of the external ISB exciter is connected to the HT-37 by a 3 foot piece of RG58A/U coax. The SSB system at K7YZZ includes a second hand Heathkit Warrior linear using four 811As in grounded grid. The system must be adjusted so that you now share that power between the two sidebands. This means that you cannot run the same SSB power on ISB as when you operate in SSB. My linear normally runs 200 mA on meter peaks when on SSB. This means that I must not run over 200 mA on ISB, or I will be over-driving that linear. I then have to divide this power between the two sidebands like this: The SSTV signal is fed to the microphone input of the HT-37 and the level adjusted so that the linear is running only around 100 mA. Then the microphone is connected to the external exciter and the gain adjusted so that on speech peaks the linear power amplifier meter moves from the SSTV level of 100 mA up to 200 mA. This means that the two independent sidebands are now sharing the power, driving my amplifier in an acceptable manner. If you wish to run more SSTV power, then increase the gain on the HT-37, but you also

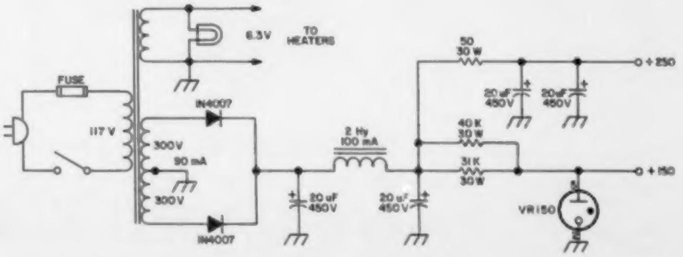
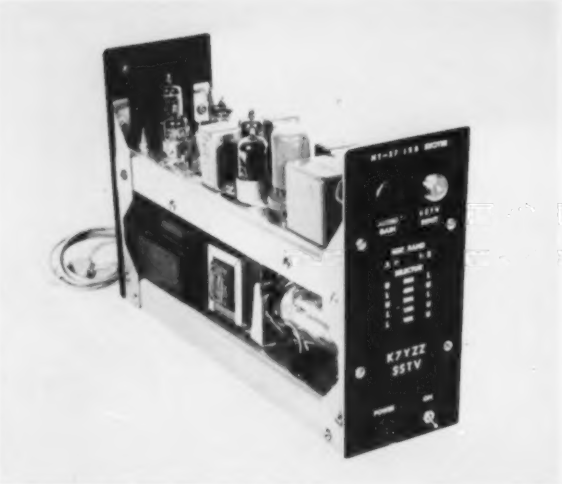
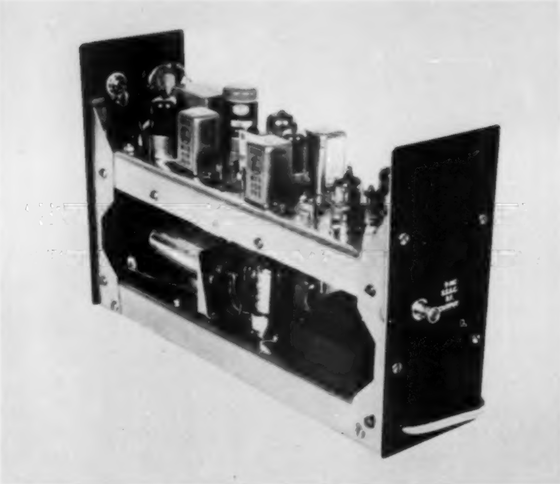


Fig. 3. Power supply.





must reduce the gain on the external ISB exciter so that the voice peaks will not exceed the power amplifier ratings.

I think probably one of the strangest things you will encounter will be the sudden realization that you are being heard at the same time you are being seen. Usually SSTV is a series of pictures followed by voice transmissions. Here suddenly you are being seen and heard at the same time, and it is quite a surprise the first time you work a station that can receive ISB SSTV transmissions. I have not gotten used to that sensation yet.

The unit described in this article has been in service for about two years and seems to hold its adjustments very well. The unwanted sideband suppression is of course not as good as a filter rig, but it is entirely acceptable for a phasing type SSB exciter. I would be pleased to hear from any other builders who are working with phasing type ISB exciters for SSTV. I wish to thank "Gervie" W7FEN, who assisted me with many on-the-air ISB tests. ■

References

[1] *Slow Scan Television Handbook*, Chapter Eight, Miller and Taggart, a *73* publication.

[2] "SSB Jr.," *G.E. Ham News*, Nov. Dec., 1950 (Vol. 5 No. 6).

[3] "Cheap and Easy SSB," A. Vitale, *QST*, March, 1956.

[4] "Single Sideband For the Radio Amateur," ARRL Publication 1965, Fourth Edition.

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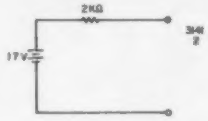
Fig. 2. Dc Thevenin equivalent network.



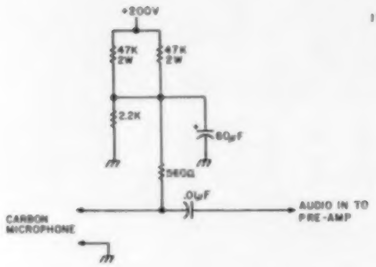


Fig. 1. Typical carbon mike input network.

Don H. Johnson WB6MXD
943 Cameron Court
Arroyo Grande CA 93420

Carbonize Your Crystal

-- a return to the carbon mike

Surplus FM units are still a good investment for the ham who wants to get on the FM bands and still have good quality equipment. For less than $100 you can get a tube-type rig which can give you 25 W output and receiver sensitivity better than a microvolt. Also, these tube-type rigs are not as susceptible to intermod and desense problems as some transistor rigs.

One problem with these radios is that they require the use of a raspy sounding carbon microphone. It would be nice to use one of the mikes from around the shack, but that means buying an amplifier to get the low level output from a ceramic, crystal or dynamic mike up to the level that is put out by a carbon mike. Then there is the problem of getting power to the preamp and/or finding someplace to mount it.

A carbon microphone is basically a resistor whose resistance is varied when a signal (voice) is applied to its input. This same definition could be applied to a transistor. So we can replace the carbon mike with a transistor which will give us enough gain to use a lower output microphone. First it is necessary to bias the transistor to "look" like a carbon mike. To do this we adjust the bias to the transistor so that the key down voltage across the transistor is the same as the key down voltage across the carbon mike.

Fig. 1 shows a typical carbon mike input network from a Motorola PA-8664, 30 W transmitter. This can be converted into a Thevenin (dc) equivalent circuit as shown in Fig. 2, or the equivalent can be determined experimentally as shown in Fig. 3. To make the measurements, momentarily key the transmitter and measure the voltage across the carbon mike button as shown in Fig. 3(a). Open circuit the path through the carbon mike and again key the transmitter as in Fig. 3(b). This time you are measuring the Thevenin voltage. Now, exchange the voltmeter for a milliammeter and measure the current drawn key down. The Thevenin resistance can be calculated by dividing the voltage in volts by the current in mA to give the resistance in K Ohms. This combination, as shown in Fig. 3(c), is a dc equivalent that allows you to experiment with various surplus transistors without having to key up your transmitter continually until you strike the right combination to bias the transistor. This equivalent can be set up using a bench power supply or a combination of batteries. It only requires a few mA, so almost anything will do.

Once the equivalent is set up you must choose what kind of mike you wish to use. If it is a low impedance dynamic mike, you will want to use a low impedance input

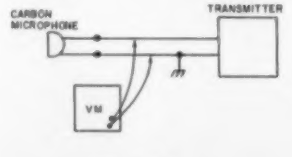


Fig. 3(a).

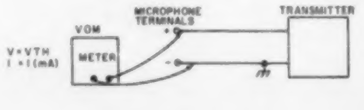


Fig. 3(b).

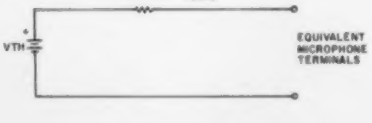


Fig. 3(c).

transistor (BJT) to get the best power transfer. For a high impedance mike, an FET will be required. I used 2N3396s for the BJTs (5/$1.00 from Poly Paks), and 2N3819s for the FETs (2/$1.00, Poly Paks). But any NPN BJT with a beta greater than 150 should work and most n-channel FETs should, too. Just be sure they can stand the open circuit voltage of the mike circuit.

The circuit for high impedance microphones is shown in Fig. 4. The FET requires a dc path from the gate to ground which is provided by the mike itself. While adjusting the bias you may want to put a resistor from gate to ground rather than a microphone. Any value from 50k to several megs should do. R_X is a 1 or 2k pot. Simply turn on the power and adjust the pot until the meter reads the same voltage as you measured across the carbon mike in Fig. 3. As an alternate method, adjust R_X until the voltage between the drain and source terminals of the FET are about one third of V_{th}. After R_X has been set, measure its value and replace it with the nearest fixed value resistor. This circuit has provided satisfactory gain, but if more should be needed it could be obtained by bypassing R_X with a small 5 uF capacitor.

The circuit for low impedance microphones is shown in Fig. 5. R_X is a high resistance pot such as one megohm. The mike does not need to be in place for the bias to be set. Simply turn on the power and adjust R_X so that the voltmeter reads the voltage in Fig. 3, or you can set it again to about one third of V_{th}. Once this is done, replace the pot with a fixed resistor of the same value and you are ready to go. You can get more gain from this circuit by dividing R_X into two resistors and bypassing the junction of these two to ground. But, again, this was not found to be necessary.

Once the mike circuits are biased, it is a simple matter to fit them into a microphone case if desired. This method is preferred but the preamp could be mounted in the control head or even on the chassis of the rig. I have used these circuits for many years and have gotten good audio reports.

Another possible use for the high impedance circuit is a quick and easy coupling circuit for a repeater which would allow taking the audio from the receiver before the audio output stage, so that you could adjust the monitor level without fear of affecting the repeat level. Also, since it has a high input impedance, you could use it for mixing several sources into one transmitter without loading effects as sources are switched on and off (see Fig. 6). ■

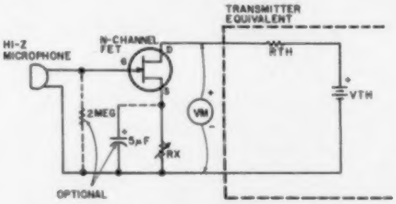

TRANSMITTER EQUIVALENT
HI-Z MICROPHONE
N-CHANNEL FET
D
G
S
RTH
VTH
VM
2MEG
5μF
RX
OPTIONAL

Fig. 4. For high impedance mikes.

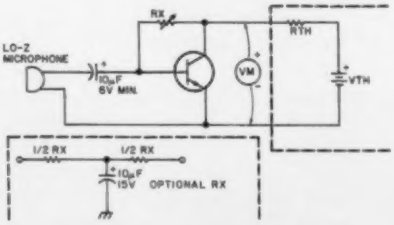

RX
LO-Z MICROPHONE
10μF 6V MIN.
VM
RTH
VTH
1/2 RX
1/2 RX
10μF 15V
OPTIONAL RX

Fig. 5. For low impedance mikes.

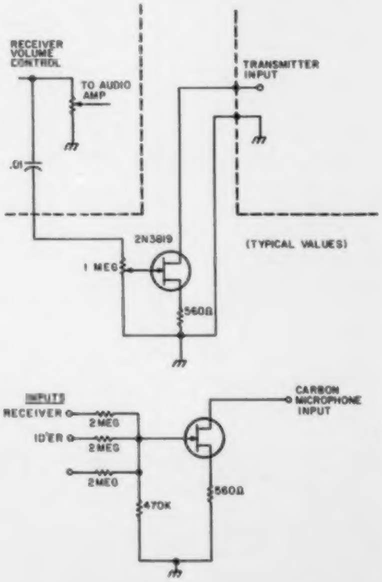

RECEIVER VOLUME CONTROL
TO AUDIO AMP
.01
TRANSMITTER INPUT
2N3819
(TYPICAL VALUES)
1 MEG
560Ω
INPUTS
RECEIVER
ID'ER
2MEG
2MEG
2MEG
470K
560Ω
CARBON MICROPHONE INPUT

Fig. 6. Typical uses.

James Eagleson WB6JNN
118 Sunnyside Avenue
Santa Cruz CA 95062

How Does Sideband Really Stack Up?

-- the SSB solution?

More and more, our VHF amateur frequencies are being eyed by commercial interests such as business and government, and personal communications needs continue to escalate. We should have had fair warning several years ago when thousands of surplus FM units were dumped on the market when overcrowded conditions forced splitting 50 kHz channels into 25 kHz ones.

Needless to say, CB Class E on 220 MHz is not the *only* threat to our VHF and UHF allocations. With fire, police, government, VHF marine, common carrier, mobile telephone, industrial, and military users all looking for new frequencies, VHF is overloaded in many metropolitan areas. The fact is that the FCC has opened a *new band* around 960 MHz (*practically microwaves*!), just to accommodate some of these stations![1]

Another fact is that there have been numerous attacks recently on portions of our bands. Class E CB, for instance, was originally proposed for two meters. Emergency medical services included several channels in the 432 MHz band in a shotgun request for frequencies for paramedical support requirements. Offshore drilling interests have successfully gotten a docket for temporary use of 432 MHz for HIRAN, a radiolocation system. This is similar to the "shared" use we suffer on 220 MHz (HIRAN is on a "non-interference" basis), where military radar takes the lion's share! There has even been a plan to replace the six meter band with TV channel 1.[2]

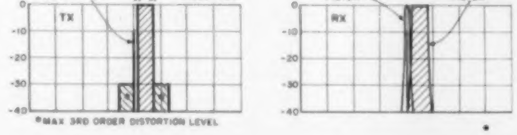


Fig. 1. Phase locked sideband. Note: Receiver sensitivity to the carrier is greater than to the sidebands, due to the 1 kHz filter. This somewhat makes up for the -10 dB level.

As you can see, "Use it or Lose it" is *not* a dead motto!

I've never been one for throwing up my hands and saying, "Oh well, you can't fight city hall or big business." Amateur radio has thrived because of brave souls who have challenged the status quo by engaging in "impossible" pursuits using "inadequate" resources. Oscars 6 and 7 are ample proof of this. You'll look long and hard to find a "professional" or government satellite that cost only $60,000. The first Oscars cost even LESS!

Back when mobile radio was being studied and it took six Amps just to light up the receiver, industrial engineers studied the strengths and weaknesses of AM, FM, and SSB.[3] AM came out third overall because of its interference problems (heterodynes), susceptibility to ignition noise, higher current drain due to the modulator, and difficulty in obtaining and maintaining a high level of modulation. FM was the ultimate winner because its limiting effect made it less prone to ignition interference, its capture effect reduced co-channel interference, its modulation requirements were simple, and "hands off" operation was characteristic because of positive squelch action and relative immunity to degradation due to off frequency operation (±1 kHz). General design considerations and economy were factors in the adoption of FM.

But technology has advanced some since this decision was made, and perhaps it is time to re-evaluate the situation in light of ever expanding needs.

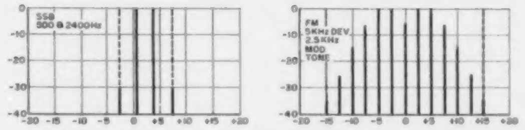


Fig. 2. Occupied bandwidth.

TYPICAL USES

The Small Fleet

Quite a bit of VHF use by small businesses is limited to one or two base stations talking to three or more mobiles. Trucking firms, farmers, security patrols, and road services are a few of the types of users that come to mind.

Normally a 25 or 100 Watt mobile serviced by a 100 Watt base station is used. Converting to SSB would require little *operational* change other than occasional touch-up of a clarifier to net mobiles to the base station frequency. As this can be done with a simple VXO circuit adjusting a few Hz, no operational difficulty exists.

Certainly the tripling of available channels, greater range, and lower current drain far outweigh the inconvenience of touching up a clarifier a few times each day!

Repeater Uses

Many users are tied one way or another to a repeater system. There are more complications with this kind of operation with SSB than with FM, admittedly, but none that are not handleable.

While translators such as those Oscar satellites use work very well, the autotuning nature of a phase locked system might be preferred.

Several means of doing this can be used. Basically, an SSB signal with a partially suppressed carrier (-6 or -10 dB) is transmitted and the receiver filters it out, limits it, and phase locks the BFO to it, so that automatic frequency control is maintained. It does not affect the other characteristics of SSB. Bandwidth is still under 3 kHz. Average power drain is still less than FM. Phase distortion is still less than FM. Additionally, a carrier-operated squelch and call-up system can be used very easily.

ADVANTAGES OF SIDEBAND

Excellent Range

Since SSB uses a narrower bandwidth, it has better weak signal efficiency. Its range is about one and one half to two times that of FM.

Narrow Bandwidth

Five kilohertz channels are not out of the question with SSB. Occupied bandwidth of less than 3 kHz yields reasonable fidelity.

Reduced Multipath Distortion

Sideband is narrow and does not depend on carrier phase, so it is far less affected by reflections and phase distortion. Even phase locked systems are not affected, as the BFO, not the transmitted carrier, is used for detection.

Simplicity

While FM transmitters are relatively simple, SSB transmitters are not that much more complicated. SSB receivers are certainly simpler than the FM receiver. Sideband modulation can be set by measuring output power and looking at an oscilloscope. FM deviation requires more complicated (and expensive) equipment.

WEAKNESSES OF SIDEBAND

Critical Tuning

The main criticism of sideband is its requirement of close tolerances. Tuning must be within 30 to 50 cycles for natural sounding reception. While in the days of tubes, crystal ovens, and 10 Amps of heaters in the box, this may have been a real problem; today's rigs with a normal multiplication factor of 12 generally hold a tolerance under 300 cycles. Since SSB is normally heterodyned up to frequency, drift can be kept to 1/12th of this, or under 30 cycles. And, of course, a clarifier system can be used over a limited range, such as plus or minus 300 cycles. Phase lock techniques may also be applied.

More Difficult Noise Suppression

While it's not difficult to recognize the greater difficulty of suppressing impulse noise, etc., in SSB, the problem is not as insoluble as one might suspect. Noise blankers, even of simple design, do very well in most cases. More complicated designs do even better. Frankly, under weak signal conditions sideband is much easier on the ears than FM's "chunk . . . chunk . . . kerchunk" and high pitched rushing.

More Difficult Tone Access, etc.

SSB is not compatible with the high accuracy subaudible systems used by many systems at the present time. There would be little problem for audible burst systems, as the frequency tolerances are not as tight as those at subaudible, but subaudible could only be used in a phase locked system. Of course, in a phase locked system the generation of subaudible would be simpler than the present system of requiring only a crystal oscillator of the appropriate frequency near the transceiver i-f. In other words, with a 10.700 i-f a 10.700.100 crystal oscillator would generate the subaudible quite easily. Cost would be about the same, of course.

Range — Putting Numbers to the Theory

Since SSB requires a receiver bandwidth less than 3 kHz for fairly good fidelity (250-3250 Hz), while FM requires about 12 kHz, sideband shows a 6 dB advantage in sensitivity (based on $\text{dB} = 10 \log \text{BW}_1/\text{BW}_2$).[4]

As only one sideband and no carrier is transmitted, there is a theoretical advantage of an additional 3 dB in the transmission of SSB. Sideband doesn't have to split its loyalties between two (or more) sidebands, as does FM.

Assuming this 9 dB advantage, one can easily see that a signal that is 9 dB out of the noise in a sideband system will not even be detectable in an equivalent FM system! While 9 dB S+N/N ratio is by no means a spectacular signal, it *is* readable, especially in an emergency situation.

Looking at it from a different viewpoint, if we assume that 1 uV is a reasonable signal level and that SSB has a 9 dB advantage in system gain, the following calculations give us some idea of sideband's range extending characteristic.[5]

$$e = \frac{3.2\, a\, h \sqrt{\text{ERP}}}{d^2\ \text{Lambda}}$$

e = 1 uV
a = 30 feet (base antenna)
h = 6 feet (mobile antenna)
ERP = 25 W x 2 (base power x ant. gain)
d = unknown
Lambda = 2 meters

Shifting the formula around yields:

$$d^2 = \frac{3.2 \times 30 \times 6 \times \sqrt{25 \times 2 \times 1^{*}}}{1\ \text{uV} \times 2\text{m}} = 2036$$

d = 45 miles

Adding the 9 dB effective gain of the SSB system, we have:

$$\text{Power gain} = \frac{9\ \text{dB}}{10}\ \text{antilog} = 7.9\ \text{times}$$

$$d^2 = \frac{3.2 \times 30 \times 6 \times \sqrt{25 \times 2 \times 1 \times 7.9}}{1\ \text{uV} \times 2\text{m}} = 5724$$

d = 75 miles

As one can see, the advantage is about 1.7:1 (75/45) for SSB over FM.

continued

---

*25 W x 2(tx ant gain) x 1(rx ant gain)

Practical Experience

With the introduction of the Echo II by KLM a short while ago, many hours of experience with VHF sideband have been logged. Since the rig is solid state, it is a natural for mobile, and many have put the rig into mobile service.

I've been involved with this mode for some time, and have noted the superiority of sideband over FM for simplex work in the rolling hills along the California coast. Between my home in Santa Cruz and my job in Watsonville (some 25 miles away), I have had only fair results with most FM stations. With SSB I am able to get very good signals from even a 3 W PEP station over the same distance, and I work several San Jose area stations with good signals (about 40 miles, through 3000 foot mountains).[6]

San Francisco Bay area stations have little trouble working simplex from mobile to base from almost anywhere in the area (about 65 miles long by 30 miles wide) and frequent contacts outside the area are logged. In fact, higher powered stations (70-140 W) are consistently working out to 125-150 miles from their mobiles, with occasional contacts out to 320 miles.

Cost Effectiveness

The introduction of the ICOM IC-202 two meter SSB walkie-talkie demonstrates clearly that the cost factor of SSB need not be higher than that for FM. This unit lists for about $270 in the U.S. Considering that the 202 has bandswitching (4 bands), VXO (200 kHz), CW, S-meter/RFO meter, noise blanker, and several features not required for normal commercial service, its price is comparable to current FM rigs. It is also well designed in technical areas. Measurements at SBE on two separate units showed transmit distortion products to be -30 dB below each tone of a two tone test (-36 dB by ARRL methods). Receiver intermodulation was 70 dB (+10 kHz and +20 kHz). Receiver sensitivity was 0.125 uV @ 10 dB S+N/N ratio. The noise blanker is quite effective, and AGC holds the audio to less than 15 dB change from 0.3 uV to over 1,000 uV.

A Chance to Participate

This is where amateur radio can do something that is in keeping with the highest tradition of its service. We can experiment with something that the commercial boys have written off (much like they wrote off those "useless" frequencies above 2 MHz years ago). Some of us on the West Coast have taken a tip from the Oscars and kicked around the idea of a sideband translator in the middle of California. Considering the direct distances common to SSB, much of the state could be covered by such a machine. Anyone interested should contact me. Others should take up the task in other areas and with other ideas (such as phase lock techniques, tone squelch, etc.).

We've already seen the potential of the mode, but more data and more active stations are needed. It's lots of fun, too, by the way! See you on two sideband? ■

References

[1] *HR Reports*, various issues, 1975.

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Son of the Overload Relay

- - if you can't buy 'em, build 'em!

In theory, an overload relay should be part of every amateur installation, especially those running high power. When placed in the negative high voltage lead, these protective devices can prevent many an expensive headache. These relays used to be listed in all the ham radio catalogs, but they are often difficult if not impossible to locate in the modern electronics emporium. However, it is relatively easy to utilize an inexpensive surplus item and to come up with a suitable overload relay. This should prove to be a worthwhile addition to any ham rig.

A surplus 24 V dc relay from the Command Set Unit is used in this circuit. This item is number 7735 and is found in the small tune-up unit, BC442, found in every complete aircraft installation. Hundreds of these units are gathering dust in ham shacks across the land, and in case you may not have a spare BC442 on hand, they are still available on the surplus market at prices as low as $5.00. For this price you will not only obtain the necessary relay, but also a very accurate and rugged rf meter with expanded scale. If your luck holds out, you might even find a surplus 50 uF vacuum condenser hooked into the back of the unit.

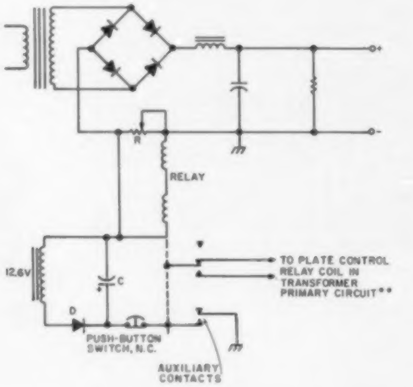
R
RELAY
12.6V
C
D
PUSH-BUTTON SWITCH, N.C.
AUXILIARY CONTACTS
TO PLATE CONTROL RELAY COIL IN TRANSFORMER PRIMARY CIRCUIT**

*Fig. 1. C – Electrolytic filter condenser, 100 uF (minimum value, preferably 250 uF), 25 V; D – Diode, ½ Ampere, 100 piv or more; Ry – Relay, part no. 7735 from Command Set Unit, BC442, resistance approx. 170 Ohms; R – Suitable for current drain, suggested starting point is 3 Watt, TV type 100 Ohm potentiometer; SW – Normally closed, push-button switch. **Note 1: Relay contacts may be used to control transformer primary directly if primary current is 5 Amperes or less. Note 2: If power transformer also furnishes filament supply, the main set of contacts may be used to open the high voltage, either in positive or negative lead, since the relay is insulated for high voltage on these contacts.*

Referring to Fig. 1, we note that when a pull-in current of some 90 mA is applied to the relay coils, the normally closed set of contacts at the end of the relay arm will now open. However, unless we employ some sort of "latching," the relay will continue to oscillate back and forth as long as the overload exists. To prevent this, the auxiliary set of contacts (normally open) are used to connect a small dc voltage to the relay coils, thus keeping the relay energized once it has been actuated by an overload.

This auxiliary voltage can be easily obtained from a small 12.6 V transformer, since only 100 mils are required at most, and even this small load is of an intermittent nature. The 12.6 V ac is rectified with a small silicon diode and filtered with a low voltage electrolytic condenser. This will give approximately 17.5 V dc, more than adequate for holding the relay in the "overload" position once it has been actuated. Or you might use a 6.3 V ac transformer with a voltage doubling circuit.

If and when the overload is removed, a quick push upon the release button will interrupt the holding current, thus restoring the relay to its normal position. Should the overload persist, the relay will be triggered again, thus protecting your valuable equipment. The purpose of the resistor R, wired in parallel with the relay coils, is to allow individual adjustment so that the relay will not kick out at normal operating currents.

The setting of the variable resistor is determined by the dc resistance of the relay coils, roughly 170 Ohms, and the amount of current that the operator desires to bypass around the relay coils. For example, assuming you want the relay circuit to kick out at 300 mA, it would be necessary to shunt a resistor of approximately 65 Ohms across the relay coils.

Some experimenters may object to the drop of 10 to 15 V when the relay is in its normal position. This is a very small loss when it is compared with an operating potential of some 2000 to 3000 V. However, for the ham running low power, the relay coils may be rewired in parallel in order to operate on half the dc voltage first mentioned for hold-in. In this case, this would be approximately 9 V dc. This can be obtained from a 6.3 V filament transformer, plus the necessary silicon diode and low voltage electrolytic filter capacitor.

In this lower voltage application, the current is roughly doubled, so it would be advisable to increase the

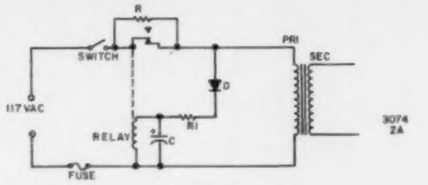

Fig. 2(a). Surge suppressor circuit, primary. For 1 kW (ICAS) power supply. Per Radio Handbook, *17th Edition, page 727. C – 800 uF, 50 V; R – 5 Ohms, 50 Watts; R1 – 600 Ohms, 10 Watts; Ry – 24 V dc, 280 Ohms (typical); D – ½ Amp, 400 piv.*

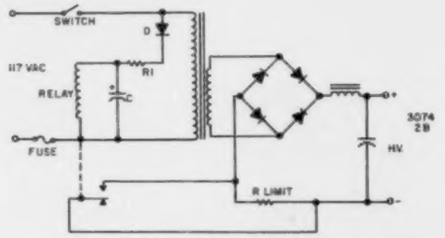

Fig. 2(b). Surge suppressor, secondary. D – ½ Amp, 400 piv; R1 – 500Ω 10 W, W.W.; C – 500 uF, 25 V; Ry – part No. 7735 from BC442; R limit – according to power, suggest 25Ω per 100 volts.

size of the filter condenser. Such a setup would be very suitable for a small linear amplifier using several TV "sweep" tubes in parallel. Some hams may find it inconvenient to ground the circuit at the two points shown on the schematic. This is overcome quite easily by mounting the relay on a small piece of bakelite. In this case, the two points in the circuit with ground connections must be "lifted" from ground and connected together.

Knowledgeable hams will spot a further function for this relay. It makes a fine shorting relay for surge suppressor use in power supplies. Most ham rigs, with condenser input, use this protective circuitry, but locate it in the primary lead to the HV transformer. This is done since suitable relays with good high voltage insulation are not usually available to the home constructor.

Commercial rigs, on the other hand, generally place the surge suppressor in the secondary of the plate supply. The current limiting resistor then becomes considerably higher in value than it would be when put in the primary circuit, roughly in proportion to the ratio of voltages. If a 120 V circuit were using a 20 Ohm resistor to limit current inrush, then a similar wattage resistor would be placed in the secondary circuit; but if the supply delivered 1200 V, the resistor ought to be roughly 200 Ohms. This would limit the inrush of current to a maximum of 6 Amps.

It is best to be on the safe side and to go to a slightly high value of resistance, rather than too low. As an example of commercial practice, the surge suppressor circuit in a 25 kW commercial television transmitter uses a 2500 Ohm, 200 W resistor, to limit current inrush to a 36 uF bank of filter condensers operating at 6500 V dc.

The values listed under Fig. 2(b) represent a compromise. Other R-C values may be used, but they will alter the time constant. ■

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No-Wire Antenna Switch

- - a clever remote system

It seems we are living in a period of shortages and, in case you hadn't noticed, we hams seem to be facing another shortage, that of coaxial cable. I don't know exactly what has caused this shortage but I do know that coax is getting tougher to get. This article describes a remote switch that can result in a substantial savings in coax and may simplify multiple antenna systems.

Originally I came up with this idea to feed a tri-band quad. Now, the quad is a fine antenna and the fact that it can easily handle three bands makes it even better. However, there is a little problem in feeding three driven elements on one antenna. Neither three feedlines nor a matching system appealed to me, and neither did using three hundred feet of RG/8U. The result was a remote switch mounted on the boom of the quad with one feedline to the shack and separate lines from the boom to each element. This saved quite a bit of coax but added a control line for the remote switch. There had to be a better way.

After some experimentation, a remote switch was perfected that did not need a separate control line, used inexpensive relays for switching, was small enough to mount on the boom of the antenna, and did not cause a noticeable increase in swr. In order to eliminate the control line, the antenna coax was used to carry dc to the relays while also carrying rf to the antenna. This dual use of a feedline is a very common practice in TV antenna preamps where the preamp is mounted on the antenna. The feedline carries power to the preamp and signal back to the set.

To accomplish the necessary switching, two relays are required. With both relaxed, the 20 meter element is connected to the main feedline. With one relay energized, 15 meters is connected, and when the other relay energizes, 10 meters is connected. To make independent selection of the relays possible, steering diodes are used in series with each relay. Then by simply reversing the polarity of the control voltage, either relay may be energized.

Remote control is handled at the operating position by the control unit, which houses a simple power supply. Referring to Fig. 1, rf is fed into the control unit at J1, passes through C1, and comes out at J2. RFC1 is used to prevent rf from entering the power supply while allowing the dc voltage to be applied to the rf line. Capacitor C1 blocks the dc from getting back into the transceiver or linear. Switch S1 is a center-off slide switch and is used to provide either a positive or negative voltage to the rf line.

At the remote switch end of the system, the rf passes through C2, through the contacts of relays K1 and K2, and out to the appropriate antenna. If no control voltage is applied to the line, rf will be fed out to J4. If a positive voltage is applied at the control unit, relay K1 will energize and rf energy will be fed out to J6. If a negative voltage is applied, relay K2 will energize and the rf will be switched to J5.

In constructing this project, it is necessary to use high quality relays for K1 and K2. Since they will probably be mounted up on the tower or even on the boom of an antenna, they must be reliable. The relays used here were surplus types of the hermetically sealed variety and had 24 volt coils. Keep in mind that, if you are using long runs of coax, there will be some loss of voltage at the relays due to the dc resis-

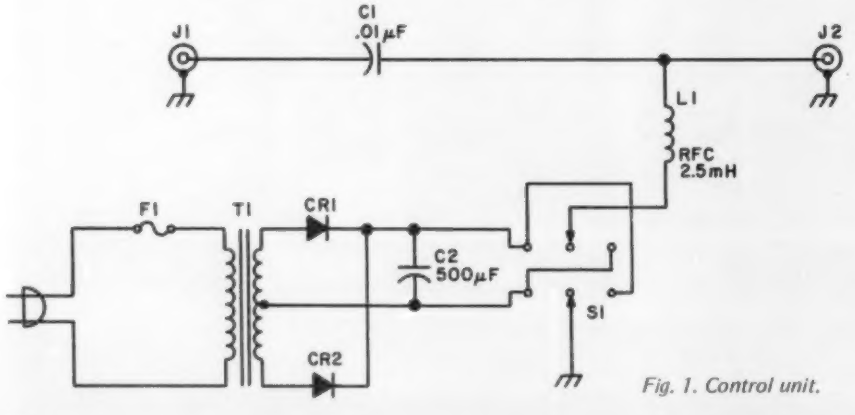

Fig. 1. Control unit.

tance of the cable and connectors. For this reason I do not recommend using relays with less than 12 volt coils. For example, the 24 volt units I used draw very little current and thus cause very little voltage drop to occur in the line. Also, the capacitors used at C1 and C2 should be capable of handling the rf power you plan to use. At the 200 Watt PEP level, I have found high quality disc ceramics satisfactory, but at higher power levels I recommend using transmitting type capacitors.

The power supply components are not specified because they will depend upon the relays used. Typically, a filament transformer and 1 A diodes should be satisfactory. Use enough capacitance in the power supply to keep the relays from chattering.

The remote end of the system should be built into a watertight container having appropriate mounting hardware to attach it to your tower or wherever you plan to locate the unit. Use coaxial cable to connect between the jacks and the relays, and anywhere the rf path is more than 1½ inches. This should result in a system with almost no reactance to cause high swr. Although I could not measure insertion loss on my unit, it appears to be very low. Below 30 MHz, I cannot tell any difference on my swr indicator when using the switch or connecting directly to my dummy load. At 2 meters it results in about 1.5:1 indicated swr. Since I only use it on HF, the swr is no problem.

This system of remote control has many possibilities other than those mentioned here. For example, if you only need it for two antennas, use only one relay. Perhaps with a little work this system could be used to switch the pattern on a set of phased verticals or wire antennas. All you have to remember in expanding upon this system is that the capacitors block dc and look like a short to rf, while the rf chokes pass dc and block rf. I have used this method in conjunction with a standard rf switch to work up a five-band antenna switch using three feedlines. Separate lines were used for 80 and 40 meters since these antennas were not located near each other, while 20, 15 and 10 meters used a single line. The saving in coax has been more than enough to offset the cost of building the switch, and not having the extra coax lines running into the shack has helped to clean up my operating area. I think you too will find this a useful and money-saving addition to your shack. ■

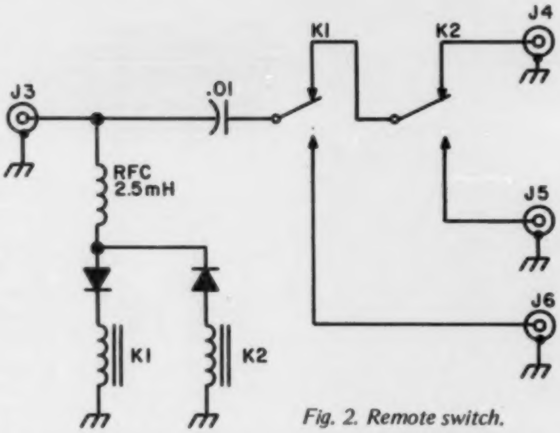

Fig. 2. Remote switch.

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The Beeper

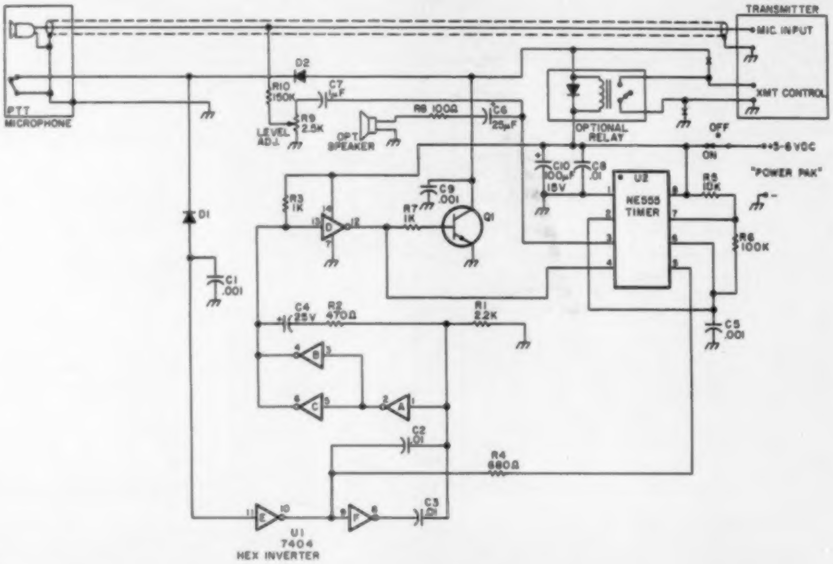
-- NASA-type beeping

For some time now, we have considered using the "begin/end" beep which NASA traditionally uses for all voice space communications. Its potential use in amateur radio, whether on the low bands, the two meter repeater band, or, for that matter, any phone band, seemed obvious. Perhaps the main concern with high noise QSOs, be it QRM, QRN, or simple wind noise when mobile, is trying to identify when the mike on the other end has been keyed or dropped. A device similar to this one has been incorporated into some repeaters, but usually only as an "out" indicator.

The specifications we desired for such a device were clear. It would:

1. Automatically initiate a beep when the mike is keyed either on or off.
2. Produce a different frequency beep for each status. We preferred to use a high tone going in and a low tone coming out.
3. Produce the tone for only about one half of a second and hold the transmitter in while it was being produced in the "out" state.
4. Be totally solid state with no use of relays or electromechanical devices.
5. Be inexpensive and easy to build, with readily available parts.

The final version was designed specifically for the Kenwood TS-520 transceiver, but a relay option was added to allow use with any transceiver or transmitter. The unit operates conveniently from a 6 V dc power cord used for calculators, tape recorders, etc. In this sense, no power supply was needed. The power cord we used was bought from a clearance supply of calculator power cords, for which there was no longer a calculator made. They are available new for about $4.99, but most surplus houses have them for half that. We found that a few power cords we tried would not work properly, causing the unit to switch back and forth between tones. This was traced to a poorly regulated supply, which caused the unit to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MIC. INPUT
XMT CONTROL
PTT
MICROPHONE
D2
R10 150K
C7 1µF
R9 2.5K
LEVEL ADJ.
R8 100Ω
C6 25µF
OPT. SPEAKER
OPTIONAL RELAY
OFF
ON
+3-6 VDC
"POWER PAK"
C10 100µF 15V
C8 .01
U2
NE555 TIMER
R5 10K
R6 100K
C5 .001
C9 .001
R3 1K
R7 1K
Q1
D1
C1 .001
C4 25V
R2 470Ω
R1 2.2K
C2 .01
R4 680Ω
C3 .01
U1 7404 HEX INVERTER

Fig. 1.

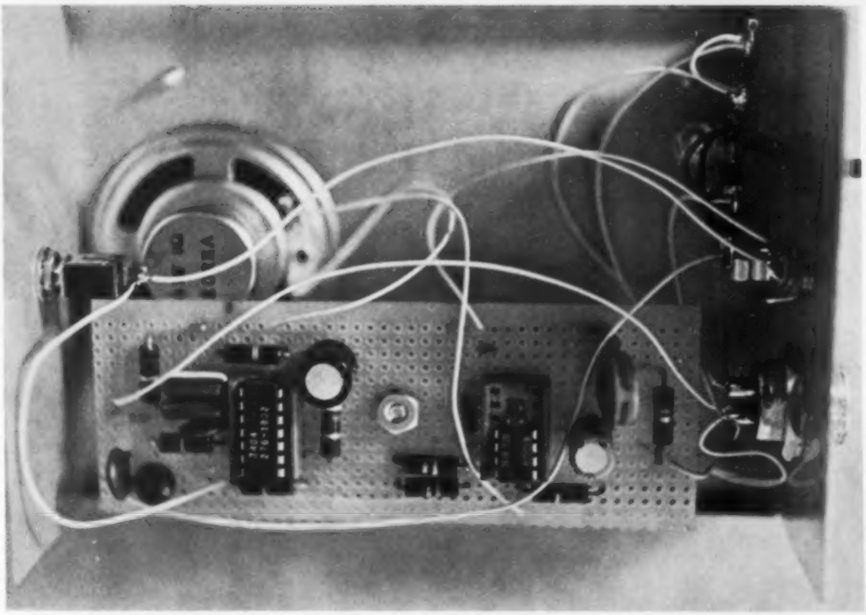
switch on and off. The unit, of course, works fine on batteries, so this method can be considered for portable operation. Also, our final version incorporated a speaker so that the operator could be assured that the unit was functioning properly. This audio feedback adds less than $1.00 to the cost, and can be disregarded if not desired. (However, this option is an attention-getter.) Finally, the beeper does not interfere with normal transceiver operation when turned off. No disconnection need be made at any time.

Basically, the "NASA Type Beeper" uses a 555 IC as a tone generator because of its ability to directly drive a speaker, be turned on and off by a TTL control signal, and vary the frequency of the tone by using the "modulator input" pin. A 7404 hex inverter provides buffering functions and a monostable multivibrator with a one half second time duration. Inverter sections A, B, and C form the monostable multivibrator. When depressed, the PTT microphone switch supplies a ground through isolation diode D1 to inverter section E. Its output goes high, sending a positive pulse through capacitor C2 and causing inverter F's output to go low. This sends a negative pulse through capacitor C3. Capacitors C2 and C3 are connected together and drive inverter A, the first stage of the monostable timer. It would appear that the opposing pulses through C2 and C3 would cancel, but the output stage of each inverter section is far better able to produce negative pulses than positive ones. A good scope shows a healthy negative pulse at the input to inverter A whenever the mike button is closed or opened. Thus the one half second time period is initiated at the beginning and end of each transmission. During this time period, the output of inverter D goes high, enabling the 555 timer and turning on transistor Q1, which is used to hold the transmitter on during the "out" status. The transmitter thereby "waits" for the "out" beep, even though the PTT switch has been turned off. The "modulation" pin of the 555 is connected through resistor R4 to the output of inverter E, so that, depending on whether the PTT switch is open or closed, a different frequency tone is produced. The tone is fed into the high impedance mike line through trimmer R9 and resistor R10. R10 should be a 10k for a low impedance microphone. The trimmer allows the tones' level to be controlled.

If the transmitter you construct this unit for requires the completion of a voltage higher than 30 volts, a negative voltage, or a system other than the grounding of 12 V dc as in the Kenwood TS-520, then the relay option should be used. The relay should operate on 6 volts at low current to reduce power consumption. Radio Shack offers an SPST 6 volt low current relay that is ideal (see Parts List).

Construction hints: The unit fits most conveniently in a 6" by 4" by 2" minibox, which allows extra room should you want to incorporate the relay. Point-to-point wiring was used on our

Photos by John Farquhar



unit, as it seemed less bother than making a printed circuit board. The ICs were mounted in sockets to allow quicker servicing or troubleshooting, but this is an "extra" and the ICs could be soldered into the circuit. One single stand-off was positioned in the center of the board, using a single screw and a few nuts. All interfacing connections were placed at the rear for cosmetic reasons and only the power switch was placed on the front panel. A few holes were drilled in the bottom of the case and a small 8 Ohm speaker was epoxied to the case. One note of caution: Shielded cable should be used between the transceiver and the beeper to prevent rf pickup.

After continual use of the unit for a month or so, we found the beeper to be a novel and useful addition to the station. We have experienced no confusion in QRM situations as to when we have switched back to the other station. In fact, operating the transceiver without the beeper on leaves quite a void now and something just seems missing. Happy beeping! ■

Parts List

R1	2.2k
R2	470 Ohm
R3	1k
R4	680 Ohm
R5	10k
R6	100k
R7	1k
R8	100 Ohm
R9	2.2k trimmer
R10	150k
U1	7404 hex inverter
U2	555 timer
C1	.001
C2	.01
C3	.01
C4	25 uF
C5	.001
C6	25 uF
C7	1 mF
C8	.01
C9	.001
C10	100 uF @ 15 V

Q1 – General purpose NPN
D1, D2 – General purpose silicon diodes
Relay (optional) – Radio Shack 275-004
Miscellaneous: SPST switch, connectors, shielded cable, power cord, speaker, mini-box

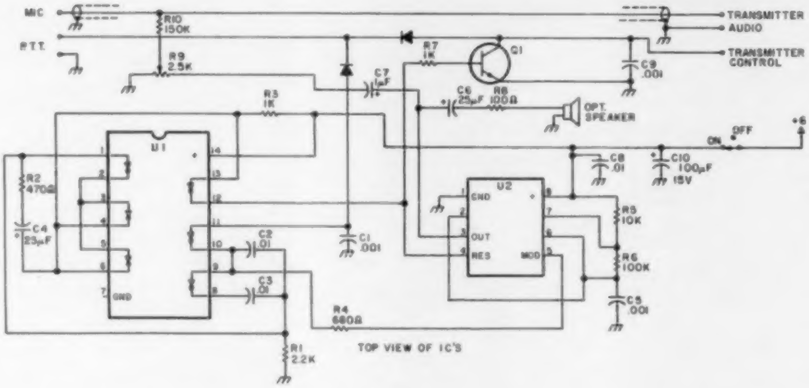

MIC
P.T.T.
R10 150K
R9 2.5K
R3 1K
R7 1K
Q1
C7 1μF
C6 25μF
R8 100Ω
C9 .001
OPT. SPEAKER
TRANSMITTER AUDIO
TRANSMITTER CONTROL
ON
OFF
+6
C8 .01
C10 100μF 15V
U1
GND
R2 470Ω
C4 25μF
C1 .001
C2 .01
C3 .01
R4 680Ω
R1 2.2K
U2
GND
OUT
RES
MOD
R5 10K
R6 100K
C5 .001
TOP VIEW OF IC'S

Fig. 2. Pin diagram.

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12 HOUR FORMAT ONLY.
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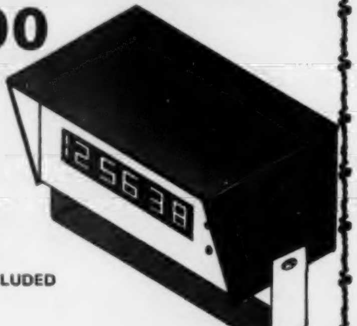

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- .4" READOUT
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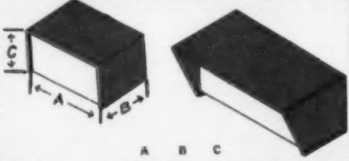

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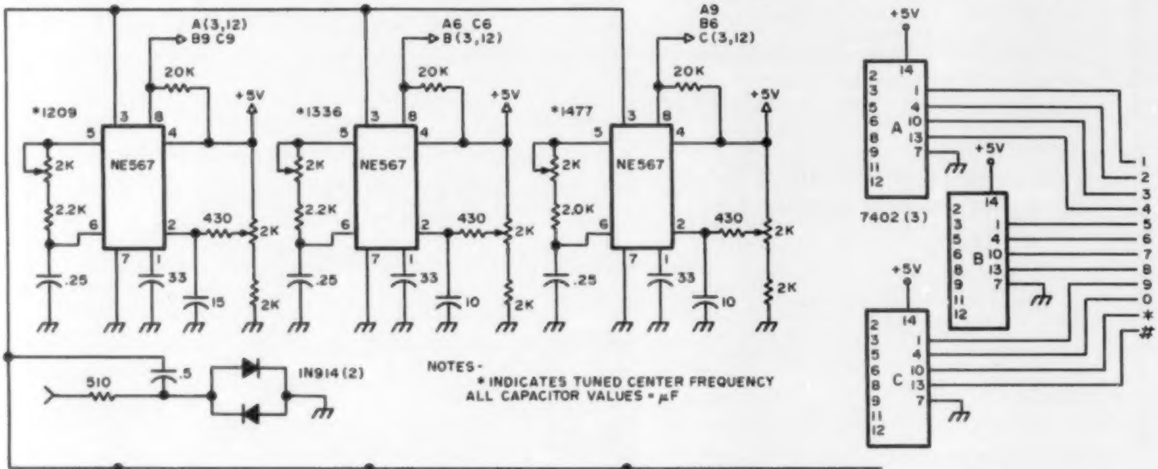
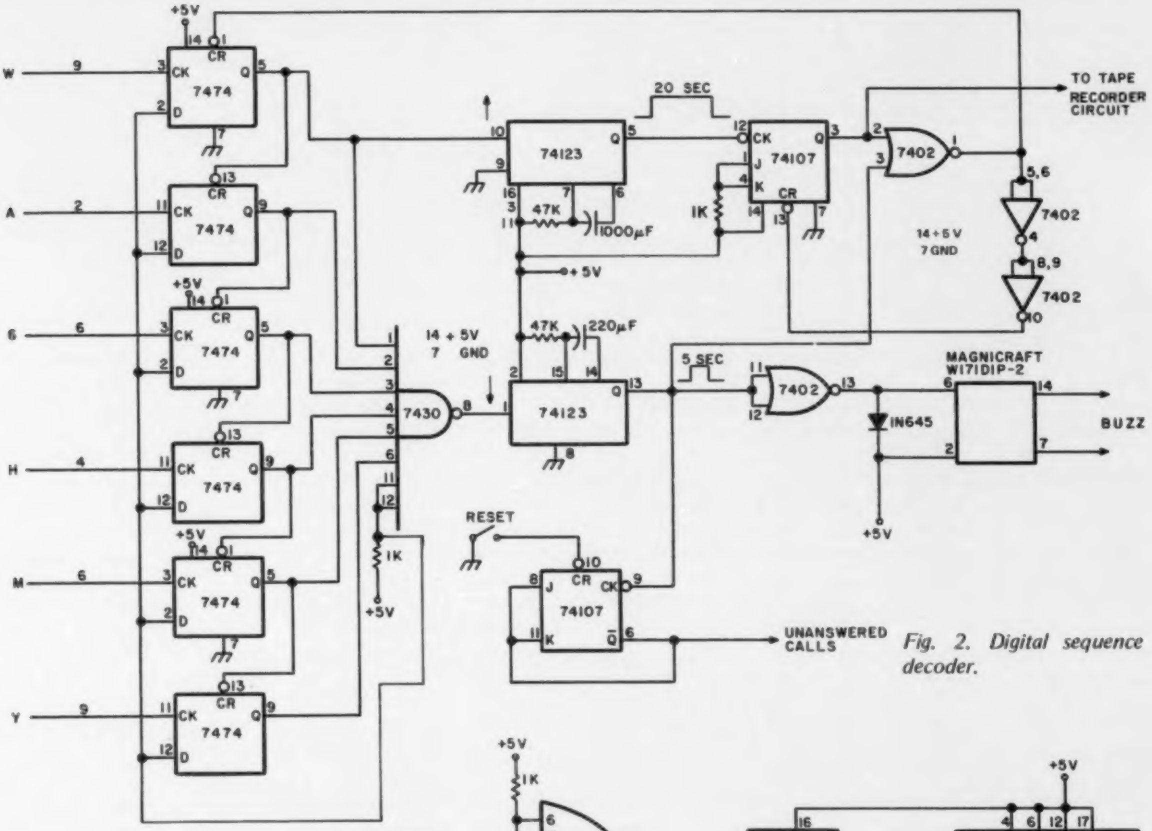
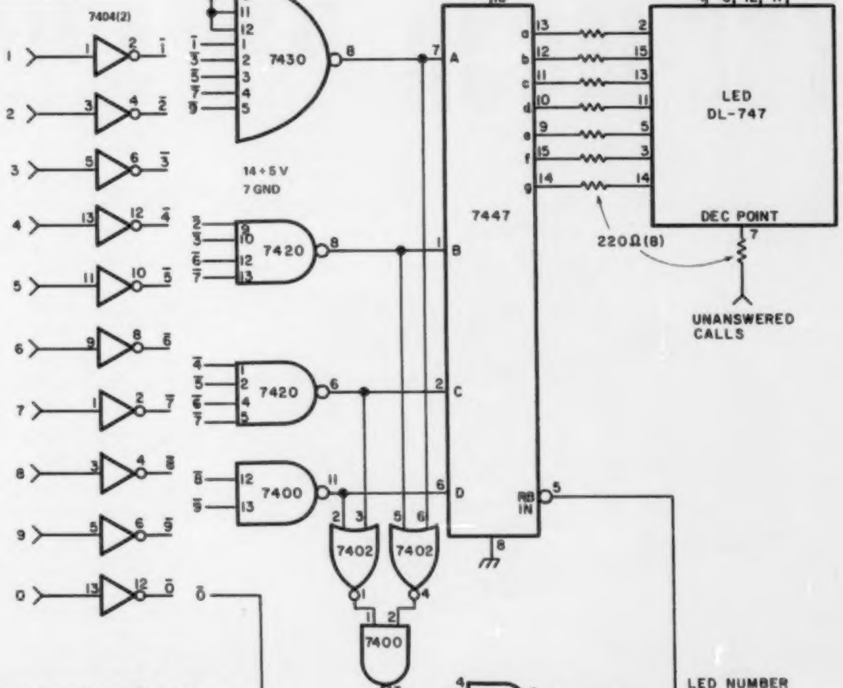

A(3,12) B9 C9
A6 C6 B(3,12)
A9 B6 C(3,12)
*1209
*1336
*1477
NE567
20K
+5V
2K
2.2K
2.0K
430
.25
33
15
10
510
.5
IN914(2)
NOTES -
* INDICATES TUNED CENTER FREQUENCY
ALL CAPACITOR VALUES = μF
+5V
A
B
C
7402 (3)
1
2
3
4
5
6
7
8
9
0
*
#
A(2,5,8)
A11 B(2,5)
B(8,11) C2
C(5,8,11)
*697
*770
*852
*941
3.9K
3.3K
47
22

Fig. 1. Tone decoder. It is good practice to bypass all Vcc pins on all chips with a .1 uF capacitor. The 5 volt power supply should be regulated to ±5 mV ripple.



W
A
6
H
M
Y
+5V
7474
CK
CR
D
Q
7430
14 + 5V
7 GND
74123
20 SEC
5 SEC
74107
J
K
47K
1000µF
220µF
1K
+5V
7402
TO TAPE RECORDER CIRCUIT
14+5V
7 GND
MAGNICRAFT W171DIP-2
1N645
BUZZ
RESET
UNANSWERED CALLS

Fig. 2. Digital sequence decoder.



7404(2)
+5V
1K
7430
14+5V
7 GND
7420
7400
7402
7447
A
B
C
D
RB IN
LED DL-747
DEC POINT
220Ω(8)
UNANSWERED CALLS
LED NUMBER DECODER

this capability to communicate from car to house. Many of us OMs have pursuaded our XYLs to get their amateur radio licenses so we can talk to them from car to house. But with all the brilliant technology of our beautifully human-engineered turnkey transceivers, there has been one big problem. The XYL won't turn on the receiver because of all "that horrible clicking and chatter from other stations."

The amateur radio telephone answering service and a touchtone pad solve this problem. It works like this: You're in the car and press up the XYL's call letters, a buzzer goes off in the house and she then turns on the speaker of the trans-

Fig. 3. LED number decoder. This is an optional circuit.

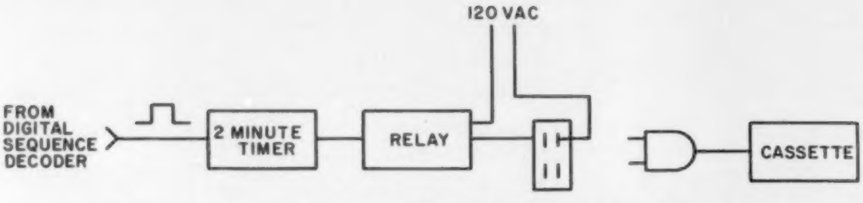


Fig. 4. Tape recorder circuit. Note: Depress record button on the cassette player.

ceiver and the QSO begins. If she missed the call she will see a light indicating a missed call and she can then play back a cassette recording of what was said on the channel.

Functional Description

Fig. 1 shows the tones coming off the transceiver speaker where they are converted to 12 digital logic outputs. For example, if the #2 touchtone pad button is depressed, the #2 line out of the tone decoder outputs 2.5 volts (a TTL logic one). All of the remaining 11 lines are .4 volts (a TTL logic zero). As the tones are decoded in a precise order, in this case WA6HMY, which is 926469, the digital sequence decoder outputs a relay closure which activates the buzzer for five seconds. When the buzzer stops, the missed call light comes on, which can be turned off with the reset switch in case other calls come in. If the reset switch is not pushed, then 15 seconds after the buzzer stops the tape recorder records what is being said on the channel for two minutes.

As the tones come in, the LED indicator will display what numbers are being sent. This is handy for checking out touchtone pads.

Circuit Description

The tone decoder circuit is taken from the Signetics application notes on phase locked loops. The values of the resistors and capacitors were calculated with my junk box in mind. The only critical component is the .25 uF capacitor used. It should be made with mica or polystyrene or of equally temperature-stable material. This circuit should be tuned up using an audio generator and a frequency counter. Put the counter on pin 5 and tune the left pot so that pin 8 pulls down to .4 volts when the counter reads the correct frequency as you adjust the audio generator. Tune the right pot to get a 4% bandwidth. There is interaction between pots, so it requires some tuning back and forth. Each of the seven phase locked loop integrated circuits are tuned to the proper frequency in this manner.

The digital sequence decoder, LED number decoder and the tape recorder circuit require no special care and feeding. One can program the sequence decoder for any callsign or name or number sequence up to six digits.

I and several other hams in this area have built and used this amateur telephone answering system. It has made more efficient use of the populated channels and allowed annoyance-free 24 hour monitoring. ■

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Dear Good Buddy

- - the perils of radio

Recently there has been a lot of loose talk about making a greater effort to recruit a new wave of radio amateurs from the CB ranks. Fraternal welcome is a nice idea, and if there are other motives, self-interest needs no defense. But candor is important too, and has anyone mentioned the hazards of hamming? Let's be decent about this; we are dealing with innocents.

When you think of all the eleven meter groundplanes sprouted among the thickets of TV Yagis and visualize a CB migration to the ham bands, TVI comes first to mind, but in fact it is a routinely soluble problem already competently dealt with in countless articles. There are subtler perils, seldom referred to, lying in wait for the artless neophyte.

One type of trouble is invited simply by the switching of roles, the assumption of a new identity in the public mind. It is commonly thought that the CB operator is a social activist seeking conviviality and opportunities to lend a stranger a helping hand, but the radio amateur is seen as less comfortably explicable – a kind of enigmatic technician who takes mysterious pleasure in messing with electrons and communicates only with others of his arcane persuasion. The operative word here is technician, and as used it means that, unlike Citizens Banders, he understands, designs, constructs and fixes electrical things. Many people really do think this, and sometimes it seems that they all live next door.

To illustrate: Your neighbor knows you have a CB set, but when the automatic ice cube gadget in his refrigerator fails, it doesn't occur to him that because you talk to people on a radio you should have the privilege of dealing with his ice cube crisis. However, if he knows you are a ham, the situation is very different. Inexplicably you are transformed into Mr. Fixit, Savant of Electricity and, needless to say, Public Servant. With the speed of light the ice cube machine magically lands in your lap. If you fix it, your fate is sealed. The word is passed from cell to cell, the failed and feeble toys gathered up, and one by one your neighbors knock on your door, burdened with electrical detritus. Some are humble and others are astonishingly peremptory, but there is a depressing uniformity about the junk culture treasures they entrust to your care – they are out of warranty, grimy with dust, sticky with the residual miasma of short-order cookery, long-parted from their proud instruction manuals and the plastic cases are cracked. Most bear unfamiliar brand names, anonymous bargains from discount stores, and have the sad appearance that means abused and unwanted.

Almost every other repair job will be a certain type of TV set, heavy and inclined to tip over slyly with the nearly imperceptible acceleration of a sleepy drunk. These are called "portables" no matter how much they weigh, presumably because they aren't in a castered cabinet fitted with a turntable, a "control center" and two boomy woofers. All are series string and after removing the cracked plastic back, shard by shard, you will find that the last tube you check will have the open filament. Reassembly will require your wife's help and the temporary application to the plastic fragments of bits of Scotch tape, Duco cement and profanity. If putting things right isn't all that simple, you can try to explain to the owner that you need and don't have the proper scope, sweep generator and other shop gear. The look you get in response will tell you instantly that he is certain you are lying, indifferent to his misfortune and too lazy to help. This is the time to tell him what you should have said in the first place: that there are many good citizens in the business community trying to make a living for their families by fixing just such beat-up old idiot boxes. Say this politely and firmly. You'll feel good, and in the silence that follows you may hear your wife snicker in the kitchen.

Children are a smaller problem, even when they are six foot teenagers, but sooner or later every kid on the block will show up with a lifeless ten dollar transistor squawk box. They all have several and when one quits it is simply stuffed in a drawer and forgotten until word about Mr. Fixit gets around. The battery holder is thoroughly corroded, the dial cord broken and an invisible crack in the circuit board testifies to the last and fatal tumble from a skidding bicycle. Fix it and the kid's dad will appear at your door with a grateful smile and an armload of sick stereo. "How come not having the speakers connected would blow the output transistors? It didn't make a sound." In return for his grateful smile, you have handed him a mystery and he regards you with suspicion. Do you explain the theory and practical application of transistors in two minutes, or do you say, "Please, sir, you must just trust me, for I am Mr. Fixit?" He has the advantage, for no good deed goes unpunished, as the philosophers point out, and by doing a favor for his son you obligated yourself – another lesson learned? But you can't turn a kid down, can you? Well, you could refuse your technical help except to runaways and orphans. The message is on the medicine label: "Keep out of reach of children."

But not to worry. Think about the bonus fringe benefits of having a ham ticket: Finally you have met all those fine neighbors you managed to avoid for years; your troubleshooting expertise has been honed and polished; you've learned so much about human nature that the rising tide of violent crime no longer perplexes you – now you think of a screwdriver as a weapon instead of a tool. No more fretting that the country is flooded with crummy unfused ac-dc junk, that behind every loose plastic knob is a metal shaft connected to the nation's power grid. You no longer wonder how much assurance is implied, and how much genuine concern expressed, when a factory affixes that "U.L." stamp or label. Newly toughened by exposure, you understand that it's a jungle out there, and one for which you were ill-prepared by the cheery ambience of CB, that Disneyland of the air waves. In return for wisdom and privilege you have forfeited your innocence, but what good was it anyway?

Once you have the free servicework panhandlers sorted out, it's a downhill feeling, and finally there is time to work some of that DX that tempted you away from the comfy slot on eleven meters where nobody bothered you. Then one evening as your wife answers the phone, there's a knock on the door and it's a whole new game. "Harry's the name, live down the street. The boy said you was a radio ham and go all over the world, right? Thought I'd say howdy to my cousin's daughter-in-law in the Peace Corps in South America. Think it's New Guinea." Take the phone, listen to a thought-gathering silence, a few hiccups and a fuzzy baritone: "Say, friend, you talk to foreigners on your little radio, huh? You admit that? Humph. Well, how about those people in Cuba and Russia? Yeah? Gummint let you do that? How ya know they're not spies? So what do ya talk to them for?" Smile and hang up.

Forget the nuts in the bleachers; what about home plate? The CB rig took up a cubic foot and cost two nights on the town, but ham gear is something else. The amateur license is in a sense a collector's item – an occult centripetal force is focused by your call letters and you will find yourself accumulating endlessly, if virtuously, in pursuit of diversity and improved performance. It's also a license to experiment – so test gear is attached, stacked and lined up neatly; surplus circuit boards and components overflow desk drawers and cartons. Discreet storage under beds and behind davenports is soon exhausted. I hate to mention money, but it is a fact that a beam can bite a budget cruelly, and a transceiver can swallow a family vacation whole. It was simpler for the old-timers, but today state of the art acceleration is phenomenal and, to the devout ham, intoxicating. Thus, "But you've only had this one a year, dear, and it looks just like new. And you were so pleased with it." The traditional reply ("Shut up and get dinner on the table") will not do. The CB rig is still in the kitchen, with sympathy on every channel. Times have changed.

Finally, it is only fair to mention that there are further risks attached to switching to hamming which, curiously enough, are concerned with the probability of making more friends. In exchange for giving up the doubtful option of anonymity ("Hey, Polish Princess, this is the Purple Cow."), hamming lets you know exactly who is on the other end of the horn. Calls, names, addresses and license class are in the callbook, so every QSO is that much more a personal and informative contact. And the diversification within the hobby (traffic nets, rag chewing, public service activities and DX riots) encourages closer contact based on shared interests. It is only fair to warn you that you may find that some of your new friends, helplessly adrift in a love affair with the electron, are inclined to take a rather light-hearted view of the more burdensome realities of life. Not to put too fine a point on it, aberration and eccentricity are not unknown in the ham community when imagination and ingenuity get out of hand.

An illustration: Not so long ago, when 21 MHz i-fs were standard in television sets, W7ATK (who shall remain nameless here), lived high in a TV-infested apartment building and an identifiable antenna would have violated a maxim of the TVI game – never blow your cover. The situation recalled an earlier and unpleasant experience with an adamantly unforgiving landlord informed by an aggrieved tenant that a trap vertical was not a "lightning rod." But the technical challenge was irresistible to a veteran of the FCC, and soon ten feet of base-loaded aluminum tubing was mounted on a bracket outside the bathroom window. Forty meters, with leakage on fifteen a calculated risk, and coil taps for moving the narrow bandwidth left and right. Atop it a plastic imitation anemometer spun merrily in the lightest breeze. Rational enough so far, but then instead of a simple ground to the plumbing, thirty-three feet of insulated wire (he refused to reveal what was on the end) was flushed down the toilet. On a table under the window the rig was disguised with a beach towel and assorted shaving gear. Bemused and too fond of inventing descriptive names for his ground system to listen to skeptical friends, ATK finally tired of wind-and-weather questions from curious neighbors and moved out of the city to a job with a broadcasting company. Long years of bossing me there encouraged early retirement, and presently he is writing a book, "It Only Hurts When It's Painful," about falling out of powered golf carts.

One more example, more illustrative of imagination then ingenuity: KL7AZH, now WA7LBX and once upon a time W7FQL, was inclined to view hamming as an avenue to unique accomplishments and "firsts" were his delight. To spare him any embarrassment from this account of one of his less successful efforts, his name won't be mentioned. He was living in a Bering Sea coastal village some years ago when suddenly he was severely afflicted with an urge to pull off an aeronautical mobile first, and since there was no way for wiser heads to prevail against a plan kept secret, he was soon airborne in an old Stinson with a pilot who had agreed to fly him from Wales over the Soviet island of Big Diomede. Visions of sugar plums danced in his head, spelling out "KL7AZH/AM/UAØ" or something like that. Now, looking back, he attributes his foolishness to his youth (he was only fifty), an unusually long winter and arctic fever. As it happened, circumstances intervened, infuriating him but preserving his spotless record with the FCC. The plane's Lear T-30 had been twiddled to eighty meters and tested with a dummy load on the ground, but over the ice floes and near the International Dateline it refused to function. Then the Lycoming radial threw enough oil to obscure the windshield, turbulence rocked the plane without mercy, and the fumes from the oil combined with fragrance from an earlier load of reindeer meat to produce pure nausea. Landing on return to Wales with vision restricted to the side windows was no problem, but someone forgot to reel in the trailing antenna with its customary beer can fluttering at the end of the wire, and this took down a salmon-drying rack before parting. As the DXpedition stepped shakily to the ground, I asked him what he had been up to. "Get out of my way before I throw up on your mukluks," he growled, and then confessed. On his desk today is a battered beer can, and he likes people to ask him what it's doing there and why a burnt-out fuse is taped to it. Dreams die hard.

Currently WA7LBX is driving himself relentlessly to bring off another first: a QSL from every licensed blonde YL in Spain. A magnificent concept. But there is reason to believe the project isn't going too well. His wife, Martha, is only grudgingly supportive and complains that his normal cheeriness has so deteriorated under stress that waking him every morning is sufficiently risky that she pokes him with a long stick, standing well clear, and at the first sign of returning consciousness expediently trots off to visit a sister nearby. Hours pass before he is safely approachable. Alas, scaling the heights is a lonely business.

But most hams are just ordinary folks, good buddy, and it would be less than honest to leave you with the impression that the two gentlemen mentioned are representative. On the other hand, it's interesting that they're not regarded as all that odd. Some do say that spending years in the comparatively more potent rf radiation field of amateur radio does make a difference, and that the five Watt CB limitation was a lucky break for you people.

Well, so much for telling it like it is, more or less. Now gather up your courage and get that ticket. You'll never regret it, and welcome to the club. ■

LETTERS

from page 9

DOC to arrive at a final policy to be presented at the ITU Conference to be held in Geneva in 1970. From the outcome of the September 29th meeting, we have learned that the lower part of our UHF band, 420-430 MHz, might still be used by Canadian amateurs on a sharing basis with other services like beacons and radio direction finding, etc. The top part, from 440-450 MHz, will be taken away from us, to be used by satellite services. This leaves us with 10 MHz (430-440) which we can call our own. Keep in mind that these changes can come about at any time. There are 5 UHF repeaters in operation in the Toronto-Hamilton area at the present, and 37 UHF links at confidential frequencies to control various 2m repeaters. All of these are in the lower and higher parts of this band, i.e., 420-430 and 440-450 MHz. Also, amateur fast scan television is quite active in this area on 439.25 MHz (international simplex freq), and with 4 MHz bandwidth. The first amateur television repeater VE3TVR in Canada is being built here as well, and already cleared by DOC one year ago. More TV repeaters are being planned for Toronto and other areas in the country. There are 5 TV repeaters in full operation in the US; the Washington repeater has been going for more than 2 years, and many more are being planned. An amateur TV repeater takes up 12 MHz of the UHF spectrum. In western Europe, TV activity is very high. In Germany, a fast scan association was founded in 1969, in the same year England founded its association; their total membership at the present is well over 4000 hams. Fast scan in Canada is rapidly increasing. Readily available surplus UHF gear and cheap surplus CCTV cameras, and the simplicity and economy of readily available solid state devices and kits, make this all possible.

To my way of thinking, we are just beginning to make use of a "giant sleeper," the 70 cm band. Too bad that we might lose it, before we have a chance to use it. I suggest we all rally together and try to save this band, because once it's gone, we will never get it back. Discuss it on the air, at your next club meeting, ask your club executive to write letters to DOC stating our position. Support your amateur organizations and persuade them to fight this, or go all the way and write letters yourself.

"United we stand, divided we fall."

John Vanderryd VE3CYC
Hamilton, Ontario, Canada

PARASITE uP?

I am writing this letter in earnest support of Mr. Donald Peasley's letter to the computer section "I/O" editorial. I originally subscribed to *73 Magazine* because I was just a neophyte to ham radio and after the mail hype that *73* sent me — "more ads, more ham-related articles" — I took the bait. The mag has gone downhill ever since. It seems that the mag has developed a predilection-turned-penchant for microprocessors and computers and the like. I can see no need for one in my shack, as my Yaesu functions superlatively as ham radio and does the job for working the world (23 countries so far). This proliferation of computer-related articles has soured my one-time favor for the magazine. How about some more articles about gadgetry for the more abundant HF gear — Heath, Yaesu, Drake, etc? If I am not mistaken, these radios all perform well without a parasite microprocessor on their backs. The references to such strange and arcane terms like byte, ROM, RAM, software, interface leave me in the dust, and frankly I have no desire to understand them. The old saying goes, "If you want something done right, then do it yourself." It is particularly apropos here, as I would like to volunteer my services as a journalist and write some articles for the more conventional hams. Shortcuts for learning the code, building up your speed, observations on the ham bands, stories, and really relevant rhetoric on the affectation that we all labor, the attraction and excitement of the distant station.

Peter G. Kendall WN3ZRG
Newtown PA

Talk is cheap, Peter — let's see some of the articles you're promising. — Wayne.

POT SHOTS

Stop the presses! A few weeks ago I wrote you a letter concerning Trigger Electronics in Illinois. In the letter I stated that I had turned to Group W Broadcasting for help through their Call for Action program and that they had agreed to assist me in getting my money back.

Well . . . last week I received a phone call from the Chicago affiliate and we talked at great length. It seems that Trigger has quite a reputation out there. They had a "considerable" case file against them. Fortunately, my order was for only a few crystals and a filter (about $35.00). A few of our brother "hams" had ordered (but never received) entire station setups ($600.00-700.00).

The only lesson here is that anyone (especially the newcomer as I was) should be most careful when making a mail order purchase, even if it *is* very difficult to locate suppliers in some parts of the country (as is the case here near Cape Cod). Although it is most frustrating to wait for gear when you are all ready to go, 'tis far better to wait and search than to pay and never receive.

It may interest you to know how I first learned about Trigger's existence (but, unfortunately, not about their reputation). When I was first licensed last year, one of my first acquisitions was the ARRL's *Radio Handbook*. In there, there is a list of suppliers. I wrote to Trigger for a catalog, assuming that anyone who is listed in the League's handbook must have their endorsement. It was not until I had trouble with Mr. Treger that I wrote and told *QST* of my problem. A return letter stated that they had not let Trigger advertise for a few years, because of his "operation." It's a case of the left hand not knowing what the right hand is doing, I guess. The handbook, by the way is a '76 edition, the latest! Must have been too costly to have the page with the suppliers list reset for the '76 printing. Otherwise, they would have stricken Trigger's name.

I wish that I had subscribed to *73 Magazine* a few months earlier than I did. I would have known about Trigger then. Oh, well, Wayne, can't cry over that. Just renew my subscription for another three years and bill me directly. Better protect myself for future purchases.

No one told me that there is more to learn than the code and some theory.

When I upgraded to a General in June, I wanted to upgrade my station as well. I turned to *73* (again) and found Tufts Radio in Medford. Let me tell you, I found them friendly, prompt and fair. A few months later I ordered (by mail) a meter from them and got it within the same week (my check didn't even have time to clear before they shipped). They'll get all my business in the future!

Hope that this letter will save another newcomer from the hassle and frustration that I went through. Although we won't have Trigger around any longer, I suppose that there may be one or two more companies that operate with similar abandon. You keep up the good work that you are doing in your magazine. As for me, well, Wayne, if I find out about another one, I'm gonna take a few pot shots at them myself. I wrote about two dozen letters, all told, with this Trigger deal. I'll write a few dozen

Continued on page 157

Do you make your own circuit boards?

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SWR Myth Exploded Again

- - how does swr really affect signal strength?

Wallace H. Provost Jr. WA1JFU
15 Park Drive
Bedford NH 03102

Back a few years ago, when I lived in Vermont, I was discussing standing waves with a well-known amateur in Altamont, New York.

"Well, Wally," he said, "I had a standing Wave in my shack but I found she looked a lot nicer sitting down when she crossed her legs–love those mini-skirts."

Obviously that topic of standing waves is fine over a glass of beer in the local pub, but it is not the subject of this article.

I assume that the reader has already read the various handbooks and back issues of this magazine, and I will not bore you with dreary theory on transmission line design but rather get right into the meat of the problem.

Fig. 1 shows a simple station arrangement. The transmitter output matching network matches the impedance of the final tubes to the impedance of the transmission line. The matching section of the antenna matches the input impedance of the antenna to the line. In this unusual but perfect condition there are no standing waves.

Under this condition the losses in the line are caused by the resistance of the conductors of the transmission line and the rf leakage across the dielectric. These figures are easily obtainable.

In Fig. 2 we have a situation that is much more common. The antenna is not matched to the line. The line is terminated in a value of impedance other than its characteristic impedance. This could be caused by improper adjustment of the matching network. It could also be from operating at a frequency other than that for which the antenna was tuned, or, as in a great many cases, the matching network may not have sufficient range to match the antenna at the frequency at which it is being used.

If the antenna impedance was different than the characteristic impedance of the line but still resistive (a very unlikely case), the standing waves on the line would look something like Fig. 3. The solid line indicates voltage variations and the dotted line indicates current variations. You will note that the phase relationship between the voltage and current nodes is always 90°. The direction, as shown in Fig. 3, is determined by the value of load resistance. This is not a normal case. Normally the phase relationship would be some figure other than 90°, and if the termination were not resistive, this departure would be greater.

Let's look at these figures for a moment and see what they tell us.

Losses: At a current loop (the points of maximum current) the increase in current flowing in the conductors causes a loss due to dc resistance. At a voltage loop, the increase in voltage causes increases in loss through additional dielectric heating.

Impedance: The effective impedance changes as you progress, being maximum at a voltage loop and minimum at a current loop.

Breakdown: Thin conductors will burn out at a current loop. Closely spaced conductors will arc over at a voltage loop.

The losses due to swr are relatively unimportant other than at high VHF or UHF frequencies. In the high frequency bands the cause of a high swr will usually affect

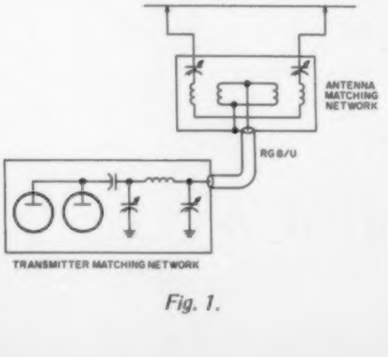

Fig. 1.

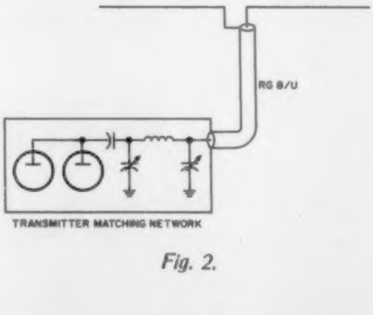

Fig. 2.

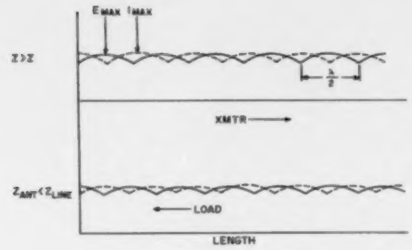

Fig. 3.

the system more than the losses in the line.

The impedance at the output connection of the transmitter, however, is extremely important. Most modern linear amplifiers do not have the ability to match a load different than their design impedance. The impedance presented to the transmitter is not the impedance of the antenna or that of the transmission line, but some other value depending on the degree of mismatch and the line length. You can see from this that in the case of moderate mismatch conditions it is possible to use the transmission line as a matching transformer, adjusting its length until the transmitter output circuit will properly match it. This, however, is a very limited and dangerous method. A number of current and voltage ratios combined with reactive elements can look good on the plate meter but cause excessive voltages across the loading capacitors of the transmitter. If you are having trouble with arcing in your amplifier, this could be the reason.

The insertion of an antenna tuner at this point will eliminate amplifier problems, but don't forget those high rf voltage problems — you have merely transferred them to the tuner. One other point: An antenna tuner will help the transmitter by providing it with a load it can match, but it does not help a poorly matched antenna and will not change the losses in the feedline.

Here are a few considerations:

1. If you were using a dipole antenna in outer space and feeding it with 50 Ohm cable, your swr would be 1.4:1. If, like mine, it is near the ground, it will be something else depending on the height and characteristics of the ground and surrounding objects.
2. The electrical length of the antenna will vary depending on the existence of nearby objects and its height above ground. This is particularly true of inverted vee type antennas.
3. If you cannot get an swr less than 1.5 on low frequency antennas, there is something wrong with the antenna.
4. On a wire antenna or a close spaced yagi antenna, do not expect a reasonable swr more than 25 kHz from the resonant frequency of the antenna.
5. Poor connections at the antenna are more common reasons for arcing than high swr. Solder all connections and wrap with plastic tape to protect from the weather. A sealant such as General Electric RTV is excellent.
6. Do not use your match box to cover up a poor antenna design; you are only kidding yourself. ■

LETTERS

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more, if I have to.

In fact, as I sit here and think of it, I wouldn't be opposed to acting as a complaint department for other hams. Tell 'em to write to me, Wayne, and I'll start case files. I have learned a lot by dealing with Trigger.

Steve Rossi WA1WGS
East Wareham MA

UPGRADE

You've tricked me into it again! I've got to write and try to answer something in the November issue.

You've asked about Technicians and 10 meters, and you've left-handedly implied that Techs should upgrade if they want to use 10. What prompts me to write is that your sentiments seem to parallel very closely those of many long-time hams of my acquaintance, namely that the name of the game is upgrade, and the name of that game is code speed. I want to try to point out an alternative to this circle.

Out there among my fellow amateurs, I'm sure there are those who feel exactly the way I do about it. I have no quarrel with upgrading except that to upgrade I must increase my code speed. Before I became a ham, I argued against code altogether, and I realize that I was wrong. Code serves a useful purpose for all hams and prospective hams. Where we differ is: "How much?" The proposals in the restructuring docket did contain one premise which I consider quite valuable, namely, advancement from Technician *without increased code speed.* I am proposing a new class of license, featuring Advanced class theory and 5 wpm code.

I personally have no interest in DXing the world on the low bands, or for DXing the states, counties or whatever. I work VHF for two primary reasons, both of which are because of its restricted range under usual conditions. First, there is the opportunity to meet most of the people I talk to, and second, DXing to any distance is a real challenge.

For some 15+ years, I have done my DXing *only* on the broadcast band (.54-1.6 MHz) and have heard 47 states and over 100 BCB countries (not to be confused with ham countries, by which count I'd have at least 20 more, or geo-political countries, of which I'd have about the same amount less). For these years, my SWL friends have badgered me almost constantly about how it was easier on SW and how I should do it that way. I don't want it that way, because of the challenge of overcoming the real obstacles presented by stations which are not designed or intended to reach across the globe. I have been actively a member and officer of the National Radio Club toward this end. (Info, write NRC Membership Ctr., Box 118, Poquonock CT 06064, if I may put in a plug.)

I am interested in antennas, and in propagation both on BCB and VHF, and would like to upgrade, but since I'll likely never use low bands or CW, I don't want to spend my hobby time beating out the code. I don't expect everyone to agree, and I might even change my mind, but let's let ham radio diversify itself even more, and cater to a wider variety of interests. In the light of your continued emphasis on CB and computers which I simply don't find interesting, this shouldn't be too outlandish a suggestion.

By the way, let's also have some more Repeater Directory updates in the magazine!

Russell J. Edmunds WB2BJH
Kinnelon NJ

EBULLIENT?

First I must let you know that whoever spoke to me one Monday at about five thirty pm was, far above the call of duty, more helpful, intelligent, receptive, vivacious and just plain ebullient than just about anyone I have ever talked to in my 30 years of business. If she is anywhere comparable to the rest of your staff, I can see why you put out such a great magazine.

I have worked hard all my life as a hardware sort of person (bulldozer hardware), but have also built all sorts of things with varying success for my business, including an unfinished submarine!?!

About 2½ years ago when the economy began to fall apart, I said to myself, "Hey, what's happening?" Since then I have become, in my opinion, a budding financial hobbyist — which quite naturally led to commodity trading. However, it didn't take me long to find out that an up to the minute running account of prices was a necessity to help prevent disas-

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Dirt Cheap Regulation

- - virtually freebee

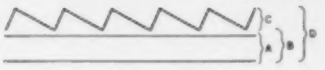

Fig. 1. (a) Reference voltage and regulator output voltage. (b) Minimum ripple voltage. (c) Ripple voltage. (d) Regulator input voltage.

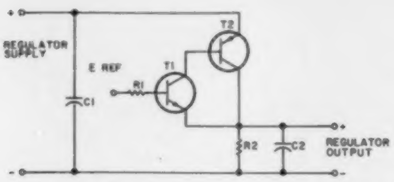

Fig. 2.

Entering the scene are transceivers, recorders and high fidelity radios, all operating on the approximately 13 volts of a car. On checking the catalog, you'll find you can expect to pay an additional thirty to fifty dollars so that you can use the same device in your home.

Although a number of regulated power supply circuits have recently been published, all have required specialized components, some of which may be available only through mail order. Here is a circuit which any ham or electronics enthusiast, who has accumulated the usual collection of unidentified transistors, diodes, resistors, and capacitors (who, in short, has the average junk box) can build a good quality regulated power supply cheaply and in a short amount of time. This regulator can provide either fixed or variable voltage as desired from either a transformer-rectifier dc source or an ordinary car battery charger.

This regulator consists of an NPN transistor in common base configuration and a PNP power transistor in common emitter configuration. The current gain of the transistor pair is the product of the gain of each of the transistors but the feedback is such that the voltage gain is unity. As a result, the output voltage of the regulator is almost exactly equal to the reference voltage. If the reference voltage is pure dc, the output voltage will also be dc and independent of the regulator supply voltage so long as the reference voltage is less than the minimal ripple voltage (Fig. 1).

The basic circuit of the regulator is as shown in Fig. 2.

T1 can be practically any NPN transistor and can be identified with an ohmmeter because the base collector and base emitter resistances of an NPN transistor will be low when the positive lead of the meter is connected to the base. Conversely, the resistances will be high when the negative lead is connected to the base. T2 should be a PNP power transistor mounted on an adequate heat sink. Most can handle a collector current of two to three Amperes. It can be identified, as it will have a low resistance between the base and either the collector or emitter with the negative terminal of the ohmmeter connected to the base.

The only moderately critical part in this circuit is C1. This capacitor should be large enough that the ripple voltage minimum is greater than the reference voltage by two or three volts. See Fig. 1(b).

Maximum ripple =
rms input x 1.5 -
2.5 - regulator output voltage
or
= peak input voltage
- 2.5 - regulator output

Thomas A. Reilly, M.D. W3GAT/2
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Jackson Heights NY 11369

C1 must have a value greater than:

$$\frac{\text{load current}}{120 \times \text{ripple voltage}}$$

where C is in farads.

C2 is optional but it can improve the transient current regulation if the load current varies widely, as occurs in class B power amplifiers. It can have a value anywhere in the range of 50 to 500 uF.

R1 should have a value between 10k and 20k and it simply limits the emitter base current of T1 should the reference voltage be present and the regulator supply voltage be off. R2 should be used either if C2 is used or if there will be times when the regulator will not be loaded. Select a value so that the current is between 1/10 and 1/20 the maximum current output of the regulator.

There are a number of methods to provide a reference voltage, and all are adequate. Remember that the quality of the reference is directly reflected in the output of the regulator.

Fig. 3 shows three methods to supply a reference voltage. Fig. 3(a) shows a zener diode reference supply. R3 should limit the zener current to about 5 mA. If C3 is larger than 500 uF the reference voltage ripple will be less than 10 millivolts. (This can be calculated with the formula used above.) Fig. 3(b) is a poor man's voltage reference. Each forward biased silicon diode will drop about 0.7 volts. So use as many as you need. Fig. 3(c) indicates a simple method to provide a variable output voltage from the regulator.

After the regulator is constructed, check the output voltage with the reference. They should be the same. If the output voltage is higher, open the base circuit of T2. The output voltage should then drop below the reference. If it does not, try another PNP transistor. If, on the other hand, the output voltage is low, there is a possibility that T1 should be replaced.

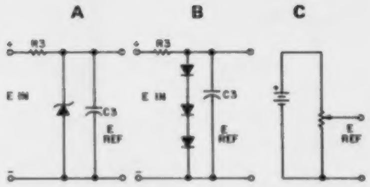


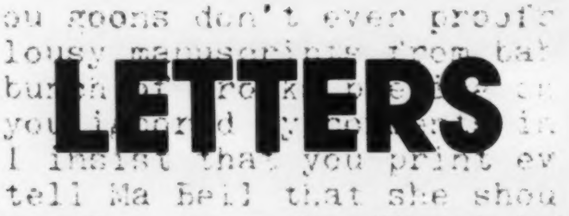
Fig. 3. (a) Zener, fixed voltage. (b) Diode, fixed voltage. (c) Variable voltage.

The voltage supply to this regulator is unfiltered dc and can most easily be obtained from an automotive battery charger, but a transformer with a full wave bridge or a full wave rectifier with sufficient voltage and current capability is fine.

I used a battery charger for a rectified ac supply which had an rms voltage of 13. The values of the components I used were: C1 – 2000 uF; C2 – not used; C3 – 500 uF; R1 – 10k, R2 – not used; R3 – 570 Ohms. With these values the regulator supplied 12.2 volts at 1.2 Amps, with a ripple of 30 millivolts. The heat sink is a piece of scrap aluminum 0.25 x 3 x 8 cm.

With a little imagination any voltage and current can be provided. There is no short circuit protection, but replacement transistors should be readily available in the junk box. So dig into your pile of unused and unidentified goodies, heat up your soldering iron, and spend a quiet hour building your brand new freebee voltage regulator. ■

LETTERS


ou goons don't ever proof
lousy manuscripts from
I insist that you print ev
tell Ma Bell that she shou

from page 157

trous losses. A letter to the Chicago board of trade revealed that they sent out their price information using a strange 6 level Baudot code over the telegraph. To quote Ayn Rand – *"Somehow"* this has to be displayed on a TV screen. For several months now I have been building a computer somewhat based on an Altair-type bus, and after reading your editorial about Morrow the Genius, it clinched my thoughts about buying his CPU and front panel (Altair) combined.

I've read the *Bug Books*, *Martin's Computer Design*, the Osborn books and a lot of other stuff (magazines, etc.), but still do not know how I'll make that 20 mA loop signal appear on a screen or a printer or – hold your hat – appear in the form of charts on a plotter or graphics screen. Do people really do these things with computers?

I've *got to* do this, so maybe your magazine, with the right software stuff, may help. I'm not smart enough to take one of your *73* articles about Morse to ASCII and make a 6 level Baudot to ASCII converter or even figure out how the computer can tell the end of one code letter or number and the beginning of the next.

I could have bought a microprocessor all built for what I've spent on mine, but I do have a pretty good idea of how it works, anyway.

I may as well mention a few suppliers who were less than perfect:

Mini Micro Mart – After many phone calls, sent me a Univac printer (3 months), which I am not sure I'll be able to use (my own incompetence) $450.00 (Model 0769).

Processor Technology – Sol terminal board not received yet; ordered in July ($40.00) after I sent practically all over the world to obtain most of the parts. They wrote and said it would be redesigned, but they forgot me, I guess.

ARB Limited, Arizona – Sent them about $50.00 for parts, not yet received (even though he called me up on the phone – seemed like a nice guy, too).

Pet Peeve – suppliers who do not refund excess money but send a credit slip which I usually lose.

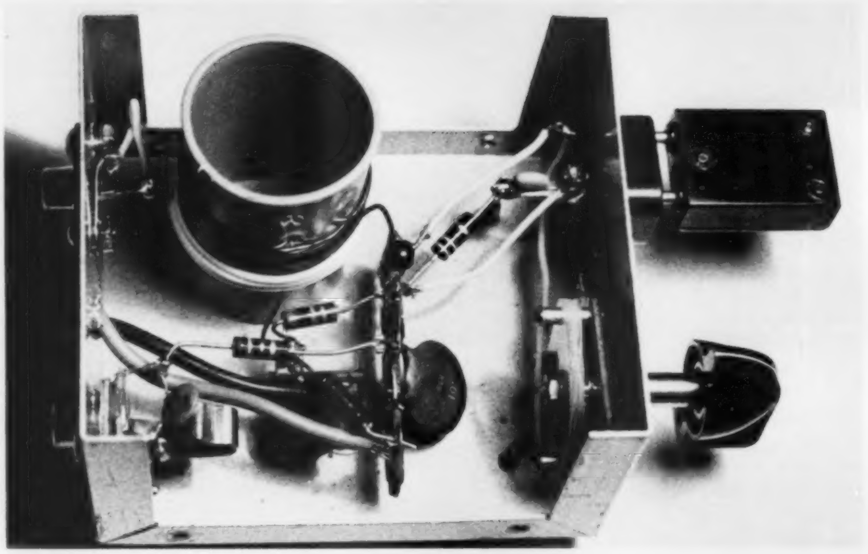
Arthur E. Bradford
Weymouth MA

LIMARC PR

"Welcome to the Wide World of Amateur Radio." With these words, narrated by the well-known CBS newsman Douglas Edwards, each Friday evening the listeners of WBAU (Garden City NY) are treated to a glimpse of what amateur radio is all about. In a pioneering effort, LIMARC (the Long Island Mobile Amateur Radio Club) has taken to the commercial FM bands to sell amateur radio to the general public. Produced and directed by Harvey Hurwitz WA2HYS and Steve Mendelsohn WA2DHF, the broadcasts attempt to provide some incentive for CB users to take that extra little step upward, and to alert the general public to the fact that there is a difference between the two services. Utilizing the studios of WBAU, located at Adelphi University in Garden City, these fifteen minute programs consist of group discussions about amateur radio versus CB, technical aspects of being an amateur, and how to find a course or the study materials required to upgrade from CB to ham. Most importantly, it highlights the differences between the two services in capabilities, scope, cost and basic requirements. No attempt is being made to downgrade the citizens band or hold it up to ridicule. We do, however, indicate by actual on-the-air recordings how different these worlds can be; for example, channel 19 compared to the local FM repeater on two meters. Short informative lectures on AMSAT, slow scan, ATV and similar subjects are given from a very light technical point of view in order to point up the vast differences between the two services. A debate was aired between an avid CB enthusiast and a group of hams with excellent results in the final on-the-air version.

One of the glaring omissions in the world of amateur radio is the critical lack of publicity. Unfortunately, this has led to many erroneous identifications in the news media where anyone with a radio was automatically called a ham. Listening to the various bands, one may often hear a tirade about the use of CB radio and its users. We must, however, face the unalterable fact that CB users outnumber hams by a staggering percentage. These numbers do constitute a vast reservoir of potential amateurs and, if the truth be known, many of our CB haters were in fact CB operators years ago. The use of the big stick technique is obviously useless, so we at LIMARC have taken this opportunity to use the soft sell. If it works for toothpaste, it should work for amateur radio. One of the local cable TV

Continued on page 163



Si Dunn K5JRN
3607 Binkley
Dallas TX 75205

A Vest Pocket QRP Rig

-- if you have a big one

"Simplify, simplify" was Henry David Thoreau's formula for a better life.

His philosophy came to mind recently while I was fumbling with some wires, cables, antenna switches, transceivers, antenna tuners, swr bridges and assorted other trappings of the ham radio hobby. Complexities are challenging sometimes, and often great fun. But they can be frustrating bores, too.

Proof is everywhere that ham radio is both progressing and becoming considerably more complex: digital readout transceivers, computerized CW keying machines, autopatches, slow scan television consoles, el-az mountings for OSCAR and EME antennas . . . sophisticated stuff when you consider where it all got started.

Can you imagine people actually communicating with *sparks*? And cat's whiskers and hunks of galena?

As I type this, I am flush with a victory for simplicity. I have just wired a tiny transistor to a crystal, three resistors and a few capacitors, made the little rig oscillate, and carried on a three-way QSO for over an hour through heavy QRM. I have just worked 400 miles with one-half Watt and a dipole that's only 15 feet high. I feel a bit like Marconi must have felt when he spanned the Atlantic for the first time. I called CQ with a piece of silicon and a hunk of quartz and two stations answered.

Simplify. I pulled out my junk box last night with the urge to build the simplest transmitter I could put on the air. It is not a marvel of engineering; it is not even a technological breakthrough. It's basic radio, and if I had my way, there would be a special ham band for basic radios and QRP wonders. As I type this, I have just tried to answer a CQ and been stomped flat by a kilowatt.

There is nothing complicated about this project. A 2N2222, available for as little as a dime, is used in a conventional crystal oscillator circuit. The oscillator is link-coupled to a low pass filter and a well-matched dipole, and that's it. The usual rules apply: Keep leads reasonably short, don't use a big soldering iron on the 2N2222, and listen to your signal to be sure you aren't chirping. Output tuning is a bit broad, so adjust C1 for best keying, even if it means giving up a few milliwatts.

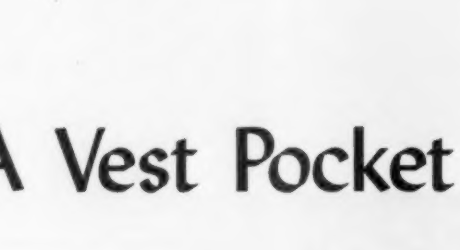

CRYSTAL
270pF DISC CERAMIC
B
C
E
Q1 2N2222
C1 365pF VAR
L1
L2
OUTPUT TO LOW-PASS FILTER & ANTENNA
3.3K 1/2W
10K 1/2W
.01
27Ω 1/2W
.001
KEY
.01
L1-17T NO.24 ON 1.25 DIA PLASTIC FORM
L2-3T LINK AROUND LOW END OF L1
12 VDC

Fig. 1. Schematic. L1 – 17 turns #24 on 1¼" dia. plastic form. L2 – 3 turn link around low end of L1. C1 – 365 pF variable capacitor.

Early mornings and daytime seem best for QRP work on 40 meters. Add two or three turns to the coil if you want to work both 80 and 40. Or add a switch and a 75 pF capacitor across C1. At 12 volts, my version draws about 45 milliamperes. The 2N2222 will get warm if the key is held down for extended periods. Warm is okay, but hot is not. Got it?

As I type this, I have just worked Tennessee – 500 miles with a 569 signal report – at high noon. Nobody believes I'm running just one transistor . . . ■

7400N TTL

SN7400N	.16	SN7459A	.25		
SN7401N	.16	SN7460N	.22	SN74154N	1.00
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SN7403N	.16	SN7472N	.39	SN74156N	.99
SN7404N	.18	SN7473N	.37	SN74157N	.99
SN7405N	.24	SN7474N	.32	SN74160N	1.25
SN7406N	.29	SN7475N	.50	SN74161N	.99
SN7407N	.29	SN7476N	.32	SN74163N	.99
SN7408N	.25	SN7479N	5.00	SN74164N	1.10
SN7409N	.25	SN7480N	.50	SN74165N	1.10
SN7410N	.18	SN7482N	.99	SN74166N	1.25
SN7411N	.30	SN7483N	.70	SN74167N	5.50
SN7412N	.33	SN7485N	.89	SN74170N	2.10
SN7413N	.45	SN7486N	.29	SN74172N	8.95
SN7414N	.70	SN7488N	3.50	SN74173N	1.50
SN7416N	.35	SN7489N	2.49	SN74174N	1.25
SN7417N	.35	SN7490N	.45	SN74175N	.99
SN7420N	.21	SN7491N	.75	SN74176N	.90
SN7421N	.33	SN7492N	.49	SN74177N	.90
SN7422N	.49	SN7493N	.49	SN74180N	.90
SN7423N	.37	SN7494N	.79	SN74181N	2.49
SN7425N	.29	SN7495N	.79	SN74182N	.95
SN7426N	.29	SN7496N	.89	SN74184N	1.95
SN7427N	.37	SN7497N	4.00	SN74185N	2.20
SN7429N	.42	SN74100N	1.00	SN74186N	15.00
SN7430N	.26	SN74107N	.39	SN74187N	6.00
SN7432N	.31	SN74121N	.39	SN74188N	3.95
SN7437N	.27	SN74122N	.39	SN74190N	1.19
SN7438N	.27	SN74123N	.50	SN74191N	1.25
SN7439N	.25	SN74125N	.60	SN74192N	.89
SN7440N	.16	SN74126N	.60	SN74193N	.89
SN7441N	.89	SN74132N	1.00	SN74194N	1.25
SN7442N	.59	SN74136N	.95	SN74195N	.75
SN7443N	.75	SN74141N	1.15	SN74196N	1.25
SN7444N	.75	SN74142N	4.00	SN74197N	.75
SN7445N	.75	SN74143N	4.50	SN74198N	1.75
SN7446N	.81	SN74144N	4.50	SN74199N	1.75
SN7447N	.69	SN74145N	1.15	SN74200N	5.50
SN7448N	.79	SN74147N	2.35	SN74279N	.90
SN7450N	.25	SN74148N	2.80	SN74251N	1.79
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CD4016	.56	CD4051	2.95	74C151	2.90
CD4017	1.35	CD4053	2.95	74C154	4.00
CD4019	.55	CD4060	3.25	74C157	2.15
CD4020	1.49	CD4066	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4081	.45	74C164	3.25
CD4025	.25	CD4511	2.50	74C173	2.00
CD4027	.69	CD4518	2.50	74C193	2.75
CD4028	1.65	CD4566	3.00	74C195	2.75
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LM308H	1.00	LM380N	1.39	LM2901N	2.95
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LM309H	1.10	LM381N	1.79	LM3900N	.55
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LM320K-12	1.35	NE560B	5.00	75451CN	.39
LM320K-15	1.35	NE561B	5.00	75452CN	.39
LM320T-5	1.75	NE562B	5.00	75453CN	.39
LM320T-5.2	1.75	NE565H	1.25	75454CN	.39
LM320T-8	1.75	NE565N	1.75	75491CN	.79
LM320T-12	1.75	NE566CN	1.25	75492CN	.89
LM320T-15	1.75	NE567H	1.95	75494CN	.89
LM320T-18	1.75	NE567V	1.50	**RCA LINEAR**	
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LM340K-6	1.95	LM723H	.55	CA3059	3.25
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LM340K-18	1.95	LM741CH	.35	CA3082	2.00
LM340K-24	1.95	LM741CN	.35	CA3083	1.60
LM340T-5	1.75	LM74114N	.39	CA3086	.85
LM340T-6	1.75	LM747H	.79	CA3089	3.75
LM340T-8	1.75	LM747N	.79	CA3091	10.20
LM340T-12	1.75	LM748H	.39	CA3123	2.15
LM340T-15	1.75	LM748N	.39	CA3130	1.39
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74LS03	.39	74LS74	.65	74LS153	1.89
74LS04	.45	74LS75	.79	74LS157	1.55
74LS05	.45	74LS76	.65	74LS162	2.25
74LS08	.39	74LS83	2.19	74LS163	2.25
74LS10	.39	74LS85	2.49	74LS164	2.25
74LS13	.79	74LS86	.65	74LS175	1.95
74LS14	2.19	74LS90	1.25	74LS181	3.69
74LS20	.39	74LS92	1.25	74LS190	2.85
74LS26	.49	74LS93	1.25	74LS191	2.85
74LS27	.45	74LS95	2.19	74LS192	2.85
74LS28	.49	74LS96	1.89	74LS193	2.85
74LS30	.39	74LS107	.65	74LS194	2.25
74LS32	.45	74LS109	.65	74LS195	2.25
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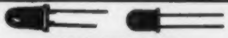

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XC209	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC111	Yellow	4/$1
			XC111	Orange	4/$1

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XC22	Red	10/$1	XC526	Red	10/$1	XC556	Red	10/$1	MV50
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	7/$1	.085" dia. Micro
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	7/$1	red LED
XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	7/$1	6/$1
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DL707

DL338

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MAN 7	Common Anode	.300	1.25	DL704	Common Cathode	.300	.99
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MAN 7Y	Common Anode-yellow	.300	1.95	DL 728	Common Cathode	.500	1.95
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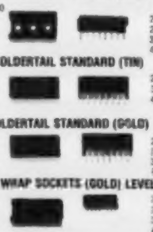
MAN 64	Common Anode-red	.400	1.75	DL 750	Common Cathode	.600	2.49
MAN 72	Common Anode	.300	1.25	DL 338	Common Cathode	.110	.99
MAN 74	Common Cathode	.300	1.50	FND70	Common Cathode	.250	.75
MAN 82	Common Anode-yellow	.300	1.75	FND503	Common Cathode	.500	1.00
MAN 84	Common Cathode-yellow	.300	1.75	FND507	Common Anode	.500	1.00

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

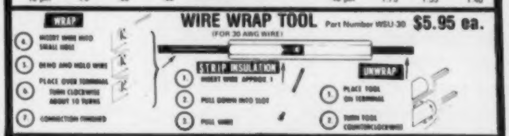
8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.50	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

WIRE WRAP TOOL Part Number WSU-30 $5.95 ea.

(FOR 30 AWG WIRE)



WIRE WRAP WIRE

30 AWG — 25 ft. min. - $2.10 50 ft. - $2.75 100 ft. - $3.50 1000 ft. - $24.00

SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	
ASST. 1	5 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% — 50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% — 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K	
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% — 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K	
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5% — 50 PCS.
		22K	27K	33K	39K	47K	
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5% — 50 PCS.
		150K	180K	220K	270K	330K	
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5% — 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M	
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% — 50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$10.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
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MINIATURE TOGGLE

SPDT				PART	1	2-9	10-29	30-99
	ON	OFF	ON	221	2.95	2.55	1.87	1.70
	ON	NONE	ON	223	2.95	2.15	1.58	1.43
	ON	OFF	ON	121	2.25	1.95	1.43	1.30
	ON	NONE	ON	123	2.05	1.95	1.21	1.10

PUSH BUTTON

SPST — SERIES PB, PB1

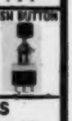
Alternate Action Switch
Push To Make Contact And Push Again To Release Action

Momentary Action Switch
Normally Open or Normally Closed: For N.C. circuit use terminals 2 & 1; for N.O. 2 & 3; for N.C. and N.O. 1, 2, & 3

PB-123 $1.75

PB-126 $1.75

5 AMP RATINGS



THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY

Part No.	Description	Price
SF 12	Single Pole 10 Position Decimal	$2.50
SR 12		3.00
SF 21	10 Position BCD only	2.50
SR 21		3.00

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

SF — Front Mount SR — Rear Mount

SERIES SF Front Mount Assembly

SERIES SR Rear Mount Assembly

ACCESSORIES

Part No.	Description	Price
SF EP	End Plate (Pair)	.90
SF DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40
SF HB	Half Body (each)	.40

ACCESSORIES

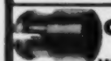
Part No.	Description	Price
SR EP	End Plates (pair)	$ .90
SR DP	Divider Plate (each)	.40
SR BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

DIP SWITCH

These switches feature seven SPST slide switches in a molded dip. They are ideally suited for microprocessor applications.

$1.95

CLIPLITE !! 4/$1.00



NEW LED
MOUNTING SYSTEM

- CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".
- CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.
- CLIPLITE is to be used with XC556 LEDS.
- Specify colors—red, green, amber, or yellow when ordering.

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400mm	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.90
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	25A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	25A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	5/$1.00			PN4249	4/$1.00
MPS A06	5/$1.00	PN3567	3/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3568	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	PN3569	4/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3704	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3705	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N4409	5/$1.00
PN2415	5/$1.00	2N3707	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3711	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N3724	$ .65	2N5088	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5089	4/$1.00
2N2925	5/$1.00	2N3903	5/$1.00	2N5129	5/$1.00
2N3053	2/$1.00	2N3904	4/$1.00	2N5138	5/$1.00
2N3055	$ .99	2N3905	4/$1.00	2N5139	5/$1.00
MJE2955	$1.40	2N3906	4/$1.00	2N5209	5/$1.00
MJE3055	$1.25	2N4013	3/$1.00	2N5951	5/$1.00
2N3392	5/$1.00	2N4014	3/$1.00	C106B1SCR	2/$1.00
2N3398	5/$1.00	2N4123	10/$1.00	2N6432	$2.00
				40673	1.75 ea.

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				**Radial Lead**			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

William E. Rabenhorst WA4VWY
Box 2542
Vero Beach FL 32960

Where You Can't Solder or Weld

- - joining dissimilar metals

About eleven years ago a close neighbor in Washington, D.C., complained of TVI several months after she purchased a new TV set. The trouble was completely cured for the time being when her husband and son-in-law took down the old antenna and cleaned all contacts on it as well as both ends of the lead-in.

On another occasion, my all-metal 20 meter quad with aluminum tube inserts (see May, 1969, *73 Magazine*) started acting up after a few months. A resistance reading through 100 feet RG8-U feeder and the quad's driven element showed a variation from pure or normal resistance for that length, at one moment, to all the way to infinity over a brief period while a normal breeze was blowing.

How often have you read or heard of adjusting the element length of a home brew beam by shoving the shorter aluminum tubing further into the end of the main tubing until the desired overall length was obtained, with nothing more than a clamp or self-seating screw to hold it in place?

Then, too, have you not at one time or another been plagued with rectification in one of your antenna systems, particularly where aluminum and copper are used?

Scraping the enamel or other factory-applied coating off copper wire used for quads beyond the point where soldering is necessary causes oxidation or corrosion on the scraped surface, particularly down here in coastal Florida where the air contains salt spray. This is said to interfere with rf, which travels on the surface of the wire. Even power line insulators during a prolonged drought as we had in 1967 can keep you guessing temporarily as to the cause of poor reception until a good shower cleans the insulators not otherwise defective.

This article is intended to help you correct at least one source of trouble – one which involves the use of *incompatible metals* such as copper and aluminum.

Some years ago, while "reading the mail," a fellow was heard to say that his backyard was full of TV antennas which he had removed on service calls and found it necessary to replace with new material. On this point, it is a fact that there is a vast difference between the 12 foot lengths of aluminum tubing of different diameters and wall thickness purchased from a well-known supplier in Washington, D.C., and the comparatively poor material in use on many antennas, whether for amateur use or TV. Down here, TV antennas are mostly anodized on the outside at least, to prevent or hinder oxidation and/or corrosion in the salt air, but amateur beam antennas are not.

In 1953 Mike A. Miller, Assistant Chief of the Process Metallurgy Division of the Aluminum Research Laboratories, New Kensington, Pa., delivered a paper at the National Spring Meeting, AWS, Houston, Texas, entitled "Joining Aluminum to Other Metals." He discussed methods of joining aluminum to other metals by fusion welding, pressure welding, brazing, soldering, diffusion welding and resin bonding. The article's abstract states in part that aluminum can be joined to a large number of other metals by various methods. The joining method chosen will depend on the metal to be joined to aluminum, the design of the parts, the permissible temperatures of joining and on the service requirements of the completed assembly.

A lot of the foregoing may be of little interest to the average ham. Although Miller said aluminum and copper may be joined for electrical applications by employing a special arc-welding technique, several telephone calls to the Baltimore firm from whom the above-mentioned paper was obtained elicited a far more simple method for use by us hams (see Fig. 1).

Fig. 1 illustrates graphically the method of joining an aluminum tuning element that is telescoped or slid into the main tube. It is suggested that you first insert E, a wood dowel, into the end of the inner section to prevent a concave surface under pressure. Then slide the tuning element F into the main tube G to arrive at the resonant frequency desired. Drill holes at A through E, F and G to permit insertion of 6/32 nickel-plated steel bolts as indicated. A copper strip, with a similar hole at each end, is then tinned at its ends, including the inside edges of the holes, and placed in position as shown at D. B, nickel-plated steel washers, are then placed above and below the holes in the plated or tinned copper strip, and the assembly fastened securely with the nickel-plated steel bolts, A, and similar nuts, C. Of course, the "contact surfaces" of the aluminum tubing must previously have been burnished or cleaned. All that remains now is to cover the joint with Amphenol silicone compound or other suitable

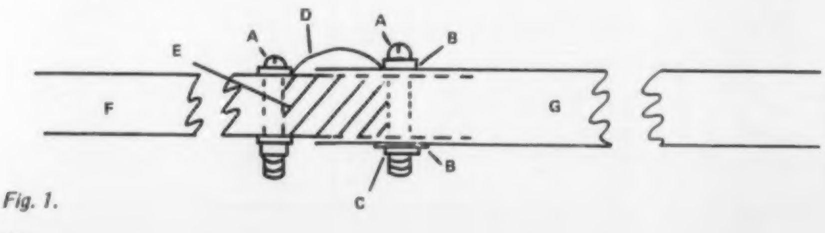


Fig. 1.

"goo" to exclude oxygen, whether from air, dew or rain.

Coax terminals at the feedpoint of a beam (see Fig. 2) are joined similarly except that the copper center conductor and the shield are substituted for the copper strip. Remember that, in Fig. 1 and Fig. 2, *no part* of the untinned copper must come in contact with the joint as illustrated, and nickel-plated steel washers are used on *both sides* of the tinned copper.

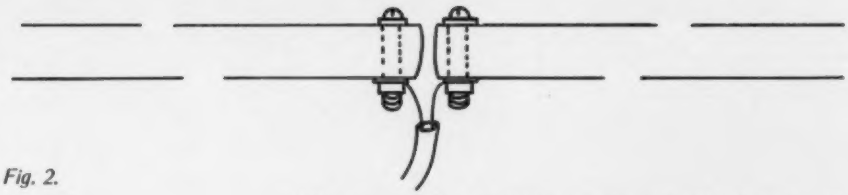


Fig. 2.

If your quad antenna uses beryllium copper wire, a better job is accomplished if the copper is silver-soldered instead of being tinned.

Aluminum or "clothesline wire" used for dipoles, fed with copper leads, are joined as in Fig. 2. Mash the ends of the aluminum wire flat; insert ends in a good vise. First drill a hole with a smaller size drill, and then enlarge the hole with a drill to take the 6/32 bolts referred to above. And don't forget the "coating."

If you are a DX hound, your antenna connections play a most important role in the power you "put out" as well as in the signals you hope to capture. ■

LETTERS

from page 159

channels has started to run these tapes on Wednesday evenings at 6:30 pm. Unlike many public service programs supplied to these stations by various sources, they have chosen to give the "Wide World of Amateur Radio" prime time, as they feel that with the high potential interest in radio communications, many CB operators will be listening at these hours. All participating stations have been warned that these tapes can only be used as a non-sponsored public service broadcast and the local amateurs have been warned that replay of these tapes or recordings made on the air can not be done on the ham bands.

Production of these shows requires the services of the WBAU studios with Bruce Barlow manning the board. A typical session will produce thirty to forty-five minutes of tape. This tape is then edited down to one or two fifteen minute shows. Our thanks go to Doug Edwards, who so kindly offered to record the open and close of each show. Editing is done at the studios of CBS New York, and we thank them for their assistance in making these shows possible. Logistically, the major difficulties involved are those of having a studio available, transporting the necessary participants to and from the studios, editing the tapes and making the necessary duplicates and getting the tape to the station on time. Being committed to a minimum of sixteen weekly shows, we have at this writing completed and aired seven shows and three are ready to go. It has been a difficult and sometimes trying experience, but we at LIMARC feel that proper exposure and adequate publicity can do nothing but help amateur radio.

Harvey Hurwitz WA2HYS
Oceanside NY

MORE JAMMING

I'm a Novice, and I've got a message for all you others who operate in the Novice bands: QUIT JAMMING!!!! Whenever I hear someone CQing, about the time I hear the guy identifying, I hear someone CQing almost right on top of him. That's not only bad procedure, that's stupidity! Some of you guys who don't venture into the Novice bands very much — go there sometime and you'll find out what I mean. You'll hear some guys CQing right on top of him and you'll never know who he was.

When I was studying for my Novice license, I knew about antennas, what frequencies I could use, and all that stuff except one thing: procedure. I didn't know how to use SK, AR, or what to say after the other guy handed it over to you. And then there are these guys who CQ anywhere without listening, usually jamming a DX QSO or trying to get the DX at somebody else's expense. And many of the League publications have been very vague about this. So, you guys, whoever's doing this, please give us guys who don't do this jamming a chance to get a decent QSO. *It ain't every man for himself, you know.*

Tom Carney WB9RXJ
Sterling IL

ONE VOTE

Keep meaning to write, but it seems like I am always too busy.

Re your I/O Editorial in October *73:* one vote for the I/O section. I do not now own a computer; however, I do hope to as soon as I find the time to get more involved. The I/O section makes me feel like I am keeping in touch; I do learn from it, and I certainly do feel that computers are a part of hamming. There will always be newcomers to hamming, hopefully, so one more big vote for the basics, i.e., what size resistor do I want to use here or why, and how do I compute what size capacitor to use there and, hopefully, just as basic material about computing. I do also enjoy the advanced articles.

I am a WW II pilot who still earns his living flying, and would like to take this opportunity to tell you how much I have enjoyed Mr. W. Sanger Green's articles, the "Autobiography of an Ancient Aviator."

Keep up the fine work; we're out here even if we don't write too often.

John G. Bilotta WA1PMK
Naugatuck CT

CRUDE, BUT NICE

I enjoyed very much your article on Tesla in the November issue. I have been trying to find some information on him, so the bibliography alone was worth the price of the magazine.

I would also like to pass on a rather crude indirect comment relative to your *Advanced Class Study Guide* made by an FCC engineer. I read the *Guide* over twice before taking my exam, and when the examiner told me that I had passed, he said "Man, you must have studied your ass off." Quite a compliment to me and *73.*

David M. Gray, Jr. WB5NZF
Moreauville LA

NOVICE HELP

I usually don't make an issue of subscribing to a mag by writing a letter, but I would like you to know I learned 5 wpm from one of your tapes I purchased in Medford, Mass. at Tufts Radio store a year ago July while on vacation in the east. It made it possible for me to get my Novice ticket, and I was wondering just the other day where I could get another one of your tapes. Hope I can do as well with it as the 5 wpm tape I learned from.

Paul E. Taylor WB9VCI
Monroeville IN

MMM

In your December, 1976, issue of *73*, page 119, you criticize Mini Micro Mart. I wish to disagree with you. I had sent in a sixty-nine dollar order for many books they offer and a keyboard which cost $27.00. This keyboard is fully ASCII encoded, case enclosed, with numerous other display switches and worth much more than their asking price.

All I'm saying is that *M.M.M.* had no problems with my order and I'll do business with them again. They seem to have no problems whatsoever.

Art Surges
Evergreen Park IL

SATISFIED

Well, I hope you're satisfied, Wayne. Even though I let my Technician ticket lapse eight years ago (I'm not much of a talker), I kept up my subscription to *73*. You kept pounding at me with 2m FM, repeaters and such. You urged me to buy your study guides and your code tapes. I just got back from the Federal Building, downtown Chicago, having easily passed the exams for my new Tech ticket. I hope you're satisfied. I am!

Chuck Neuman
Skokie IL

WHICH uP?

Congratulations on your new magazine, for which I have enclosed a subscription. I talked with you when you were in Jordan and also when you were in FO8 as well as several times on 20 meters when I lived in Oakland.

I just got started getting into computers. Thought the Kim 2 looked pretty good; however, thought I would wait for your magazine and get the information about many of the others.

My very best wishes for your continued success and good health.

Edward Van Bosch W6KDI
Walnut Creek CA

Otto Balke, Jr. WA0CKG
1804 Rose Drive
Columbia MO 65201

Exciting New Touchtone IC

--make phone calls with your HT

After many tries and an equal number of failures to get the rf out of my MH8900 chip, I had just about given up on using the beautiful Chromerics keyboard which I had optimistically mounted on my rig. Then I saw the specs on the MC14410 chip. Too good to be true!

I sent off to Data Signal, Inc., for the chip, printed circuit board and components. The Data Signal circuit is shown in my diagram in the dotted lines. This is a great combination, and is so small that it will fit almost any corner of most rigs (lots of room even with the large crystal in my Wilson HT).

To keep a short story short, I wired up the board, installed it, and it worked. There was adequate drive for full deviation and the first attempt brought up the autopatch. So far so good.

Now, how to automatically key the transmitter when a key is depressed. Everyone who has operated mobile has had the mike cord wrapped around the steering wheel at some embarrassing time. You just can't drive, push buttons and key a mike all at once! After a voltmeter, mA meter and scope check of the entire circuit, there was no apparent place to obtain a good reliable indicator that a key has been depressed.

Enter the ubiquitous 741, the problem solver where all else fails. The 741 is stabilized in the off condition via R7, R8, and R9. A small tone signal is picked off the original circuit at the junction of the two 3.9k resistors and coupled to pin 3 of the 741 by the .01 ceramic cap. When a key is depressed, the 741 amplifies the tone and converts it into a series of plus 12 volt pulses. These are rectified by the diode which pumps the 2.2 uF electrolytic cap. This in turn switches on the NPN transistor, picking the relay. The 2.2 uF cap determines the hold on time for the transmitter. Leakage of the cap and other components eliminates the need for R11.

Adjustments

The only adjustments required are the selection of the electrolytic capacitor (I used 2.2 uF) to determine the "hold on" time of the transmitter, and the adjustment of R5. To adjust R5, put a voltmeter on pin 6 of the 741 and find the point where the 741 turns off with no signal (no key depressed) applied. Gradually go in the off direction while depressing a key. The point where the 741 remains off with the key depressed is the low limit. Set the pot half way between the no signal off point and the key depressed off point for best reliability.

R6 was added to take some of the load off the zener diode when used for mobile operation. The regulated 5.1 volts is used to bias the 741 to assure more stable operation. ■

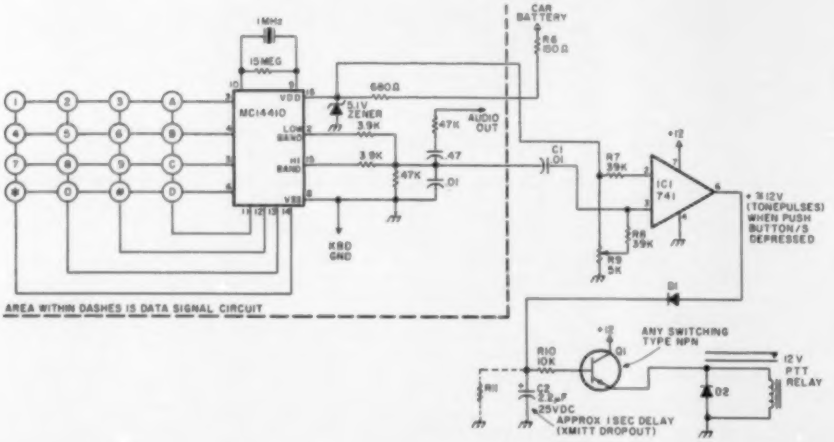

1MHz
15MEG
MC14410
VDD
LOW BAND
HI BAND
VSS
1
2
3
A
4
5
6
B
7
8
9
C
*
0
#
D
5.1V ZENER
680Ω
3.9K
3.9K
47K
47K
.47
.01
AUDIO OUT
KBD GND
CAR BATTERY
R6 150Ω
C1 .01
R7 39K
R8 39K
R9 5K
+12
IC1 741
+ ≅12V (TONEPULSES) WHEN PUSH BUTTON/S DEPRESSED
D1
AREA WITHIN DASHES IS DATA SIGNAL CIRCUIT
+12
ANY SWITCHING TYPE NPN
Q1
R10 10K
R11
C2 2.2µF 25VDC
APPROX 1SEC DELAY (XMITT DROPOUT)
D2
12V PTT RELAY

Fig. 1. Touchtone automatic keying circuit (transmitter) for the MC14410 chip. All resistors ¼ Watt.

Parts List

R6 – 150 Ohm ¼ Watt
R7, 8 – 39k Ohm ¼ Watt
R9 – 5k multi-turn trim pot
R10 – 10k Ohm ¼ Watt
C1 – .01 uF 10 V ceramic
C2 – 2.2 uF 25 V dc electrolytic
D1, 2 – 1N4001 or equiv. (not critical)
Q1 – 2N3567 NPN (any switching NPN which will carry the relay current will work)
IC1 – 741 op amp

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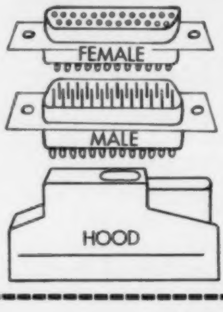

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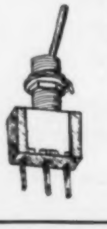

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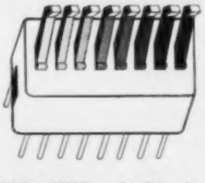

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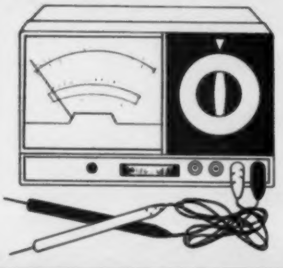

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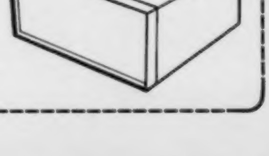

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Revisiting the COR

- - improvements on the April '76 model

William Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

The circuit I presented in the April, 1976, issue of *73 Magazine* worked just fine for me for six or eight months, but then my ham instinct to "add on" overcame my better judgment and I decided to improve the system. During that eight month period I had jury-rigged an identifier keying circuit on the original COR to key an identifier I had built. I wanted to clean up that rat's nest and add some features such as adjustable dropout delay to the COR so modification of the original became a necessity.

Features

In the revised unit, I wanted some extra features. These included dropout delay, transmitter time-out, control inhibit, and extra keying contacts for such uses as an identifier. I also decided, as long as I was about it, that I would put the whole mess on plug-in circuit boards and bring controls for the above delays and times out to the front panel.

Circuit

The revised circuit is shown in Fig. 1. The original relay is now replaced with a NOR gate, U1A. The input to U1A from the COR also triggers monostable U2 on the trailing edge. The output of U2 then goes back to the input of U1A and keeps its output low for a short time after COR release. This time period is adjustable and on mine is a front panel control. The 1 uF capacitor on U2 will be covered later in the article.

The second part of U1, U1B, uses the output of U1A and a low (ground) on the control line to produce a high on its output. The high output of U1B drives relay RY1 and also an LED indicator (optional). I use the relay contacts for PTT, ID key, and other uses.

Diode D1 and SCR Q5 are the active elements of the time-out circuit. D1 is present because the SCR I had would not turn Q4 off completely. Transistor Q5 is driven from U1A, which is high when no signal is present (squelched). This turns Q5 on and prevents C4 from charging. When the receiver unsquelches, Q5 turns off and C4 charges until Q7 turns on, which in turn opens the PTT relay. With the values shown, the time-out should be adjustable from about 50 seconds to about 3 minutes.

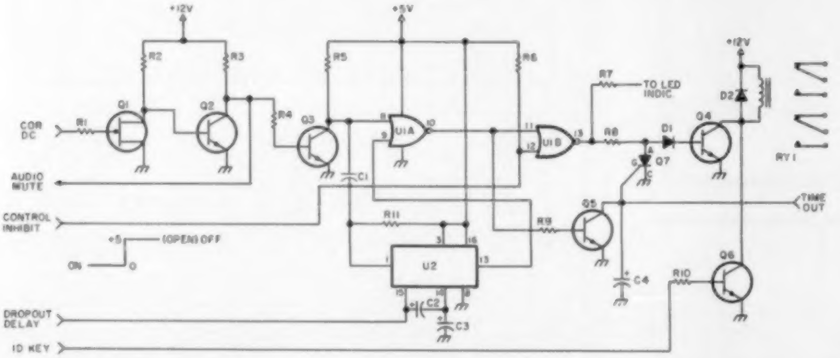


Fig. 1. Complete circuit of the COR/TIMER. The circuit requires a ground on "control inhibit" to operate. "Audio Mute" goes back to my audio interface board to shut off the audio during the dropout delay.

One more circuit is added, and that is Q6. Q6 is driven from the keying output of my IDer and turns the PTT relay on without triggering the COR or timer circuits.

Operation

I put the above circuit all together on the bench and it worked perfectly. I then built it on plug-in circuit boards and, wonder of wonders, it still worked. I then mounted that board and the identifier I had built in a logic rack on a new repeater panel recently built. I hooked up all the lines, powered the beast up and – ouch! – every time I keyed it up, it would retrigger itself every few seconds until I hit the control inhibit. It just sat there going click . . . click . . . click . . . ad infinitum.

I immediately took the standard TTL logic fixup mode. I put .01 uF capacitors on every chip and on every line that I possibly thought could help. To make a long story sad and short . . . it didn't work.

To make a short story out of several days of gloom and despair, I finally cured the problem entirely by accident. I accidently shorted a 1 uF capacitor from the timing pin on U2 (pin 14) to ground, and the problem went away. Although I had fears of drastically altering the timing, I still hung the 1 uF there and proceeded to test. Repeated tests indicated that the original problem had gone away and the timing had not been changed.

Conclusion

The circuit of Fig. 1 is now part of a control rack which contains the COR/PTT circuits, my IDer, and some audio interface circuits in addition to the control decoders. Fig. 2 shows the front panel controls I used.

Although I put mine on a multi-purpose, plug-in circuit card, I did design a printed circuit board for the circuit and they can be obtained from CONTACT R&D, 35 W. Fairmont Drive, Tempe AZ 85281 for $4.95 ppd. Also I am preparing a plug-in circuit board for the COR plus a single function tone control which should be ready by the time this gets published. Write to CONTACT for details. ■

Parts List

R1 – 1 M
R2 – 3.3k
R3 – 3.3k
R4 – 1k
R5 – 3.3k
R6, 11 – 4.7k
R7 – 470
R8 – 1k
R9 – 2.2k
R10 – 2.2k
Ry1 – 12 volt relay
C1 – 0.1 uF
C2 – 100 uF/12 V
C3 – 1 uF/12 V
C4 – 400 uF/12 V

D1 – 1N914/1N4148
D2 – 1N4001 or equiv.
Q1 – MPF102 or equiv.
Q2-Q6 – MPS6521
Q7 – 2N5060 or equiv. plastic SCR
U1 – 7402
U2 – 74123
Fixed resistors are all ¼ Watt 10%.
Panel Parts:
R12 – 50k
R13 – 50k
R14 – 5 Meg
LED (optional)

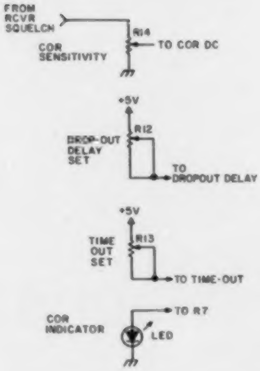


Fig. 2. Front panel controls. These can be put on the board if desired.

NEVER SAY DIE
...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 4

to get every club member to work a mention of the special guest into his contacts, not only for the chap he is talking with to hear, but for all local listeners. Some clubs have had great success with phone canvasses of every ham in the area, for getting them out to a special meeting is the first step toward getting them to join the club.

WHAT TO ADVERTISE

Just saying that some joker is going to be there to speak isn't likely to get people out. You may think your speaker is famous, but the chances are that a lot of hams won't agree. As in all advertising, think in terms of what the benefits are to the chap you want to come. Will he be really entertained? Tell him so. Will he also learn a lot which will be of value to him? Tell him!

When I talk to ham clubs I tell a lot of things that I could never print in the magazine. Our lawyers won't even let me tell you what well-known ham firms we've been having serious troubles with, and what the problems are. You might just get a lot of inside dope on what is happening in amateur radio, not only with manufacturers and dealers, but with some of the ham magazines.

Some hams would like to know the real inside information on what is going on with the FCC, with the ARRL, with *CQ Magazine*, with the coming WARC, and things like that. I kind of hint around a bit about these in *73*, but at a club meeting I answer all questions . . . even questions about *73* and *Kilobaud*.

Find out what your speaker may be able to talk about to enthuse the listeners, and stress that in the PR. The above two paragraphs were merely by way of example – please don't ask *me* to come and talk. I try to plan my life so I can just barely, with a very few hours of sleep and a seven day week, get 90% of what I should do done, with no time allocated for talking. On the few occasions when I talk to a group, mostly at conventions, I make a tape . . . and copies of the tapes are available.

DOLLAR AN HOUR

A few old-timers may remember with nostalgia the days when someone making a dollar an hour wasn't doing all that badly. If you happen to know any of these chaps, wake them up and tell them that Wayne Green has figured out a way to get back to those good old days . . . back to a dollar an hour!

Heck, I was chief engineer of a thousand Watt broadcast station at one time and made 90¢ an hour. Fortunately I worked a 90 hour week, so it did mount up. And the 90 hour week left no time to spend any of the money, so I saved doubly and eventually was able to buy my freedom.

So how do we get back to a dollar an hour? Simplest thing in the world – all we have to do is change our day to 100 hours instead of 24. This will make decimal time possible and simplify watches. Sixty minutes in an hour is ridiculous – shame on you putting up with such a nutty system for all these years.

If we change to a 30 hour work day we'd make about $150 per week at a dollar an hour. That would be a slightly smaller percentage of our normal working time (the 8 hour day), but not a lot.

The next step would be to have 100 minutes per hour instead of 60. This would make a new minute last about 8½ seconds, which should be long enough for anyone. We might call them centihours, with millihours being 0.85 seconds long.

Oh well, if you're going to fight every new idea that comes up . . .

NOVICE MAGAZINES ACOMING?

Yes, yes, I've read that stuff about a "new" *CQ* . . . pardon me for being a bit jaded as far as "new" *CQ*s go . . . they seem to be periodic fantasies which quickly fade away . . . and I would have put the present circulation of the magazine at more like 7,500 than the 40,000 claimed . . . either way some changes won't hurt.

While there is a need for more articles for beginners, my own feeling is that beginners are just as interested as anyone else in the state of the art and developments in all of the 25 or so hobbies which make up amateur radio . . . thus while there is a need for more fundamental type articles in the ham magazines, I doubt that there is much of a need for whole magazines devoted to "run, Spot, run" level articles.

The major interest at *CQ* has been in CB for a long time now and, other than a fast hormone shot to ailing old *CQ*, I wonder how long any interest will hold up in their loser. Money talks, and *S9* is where the money is. We'll see.

Ham Radio magazine has also announced a Novice magazine, but I'll be surprised if this doesn't eventually become a section of *HR* and sort of fade away.

And not to leave any charges of favoritism, I must mention *QST* too, much as it goes against the grain. They've been doing some strange things down there in Newington recently . . . I write and ask them about it now and then, but they don't answer my letters. For instance, at conventions I've been getting a continuous barrage of visitors to the *73* booth volunteering that they have dropped their subscriptions to *QST*. And I know there is serious concern in Newington over this, complete with a questionnaire to readers asking what it is about *QST* that they don't like. Yet, on the other hand, *QST* has been claiming incredible increases in circulation . . . a puzzle. Things fell into place a bit when during the New Orleans ARRL Convention an official explained that *QST* was now sending two copies of the magazine free to 30,000 libraries.

The recent ARRL claims have been for 135,000 copies distributed, so 60,000 to libraries would leave 60,000 to members, 10,000 for radio stores and 5000 for back issue sales, almost exactly what I had estimated. They can afford to send a lot of copies for nothing because *QST* enjoys an incredibly low postal rate . . . around 2¢ a copy the last time I got the figures on it. I haven't checked the cost per copy for mailing *73* lately, but I do know we are paying 70¢ per copy for *Kilobaud* magazine, and it is only 144 pages as against 208 or so for *73*.

None of this is of any real significance to readers . . . what counts in the long run is whether the magazine is interesting and really worth the money it costs. If the new Novice magazines meet this requirement, they will sell well.

THE PLAYBOYS

I got some reports on the New Jersey Playboy Club ARRL Convention . . . one from a ham who went there . . . disappointed, said many people left early. Another from a ham dealer who said it was great . . . lots of people, and they were spending money . . . always a pleasant thing for dealers.

Several of the exhibitors got a rude shock when a man showed up demanding that they collect tax on all sales and give it to him before they left. Tufts stood up to the guy, pointing out that no tax was due on sales made by out-of-state vendors, unless they were licensed by the state. Out-of-state vendors can sell if they only come in once a year; otherwise, they are supposed to get a license and collect tax. The tax man shut up when this was explained, and went away . . . never to be seen again.

Word is that one exhibitor was merrily charging the tax anyway, and the suspicion is that they did not turn in this money to New Jersey. Tsk.

One hint to readers . . . if you find yourself being charged a sales tax by an exhibitor at a hamfest who is there from out of state, get a receipt for the tax and check with your state to make sure the money was turned in. While none of us like to pay a tax, we don't want to be ripped off for the money either.

The Mighty Magnet Mount Antenna

-- the price is right: zilch

George Hovorka WA1PDY
674 Brush Hill Rd.
Milton MA 02186

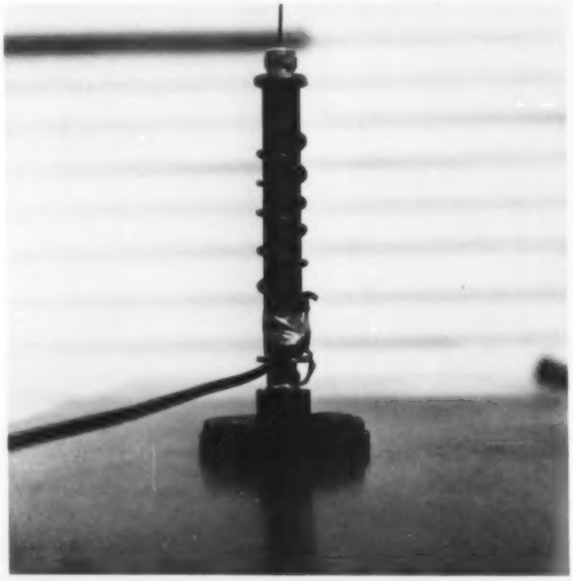
Here is a truly versatile magnetic mount two meter antenna that is easy to build. The heart of this antenna is the magnet, which must be able to retain its grip at high driving speeds and when low hanging branches hit the antenna. After some searching in my basement for a suitable magnet, I found a burned-out twelve inch loudspeaker. The speaker had originally been used in a rock and roll guitar amplifier and had a large 2½ lb. ceramic magnet. Such a speaker could be picked up gratis from any musical repair shop.

Assembling The Antenna

Before handling the magnet, remove your watch. Treat the magnet gently, since the ceramic is brittle like glass. Carefully remove the magnet assembly from the loudspeaker frame with a small cold chisel. Now remove the metal pole pieces that sandwich the magnet. These are usually lightly glued to the magnet and can be removed with the aid of a rubber hammer. The larger pole piece is turned over and glued to the top of the magnet with epoxy (see photo).

On the top of the magnet assembly, a loading coil is placed. I used an old high voltage insulator, but almost any insulating material such as phenolic, plastic rod or pipe will do. If copper pipe caps are epoxied to each end, this would form a suitable coil form. Another excellent coil form would be a large blown-out cartridge fuse which your local power company may be able to provide. The dimensions used are not too critical and can be anything from ¾ to 1¼ inches in diameter and about 8 inches high.

On this form 9 turns of #14 gauge copper wire is wound. The type of wire is not terribly critical and thinner wire could be used. As a radiating element, a 39 inch piece of coathanger or other stiff wire is used. For my antenna, I straightened



Close-up view of base and loading coil.

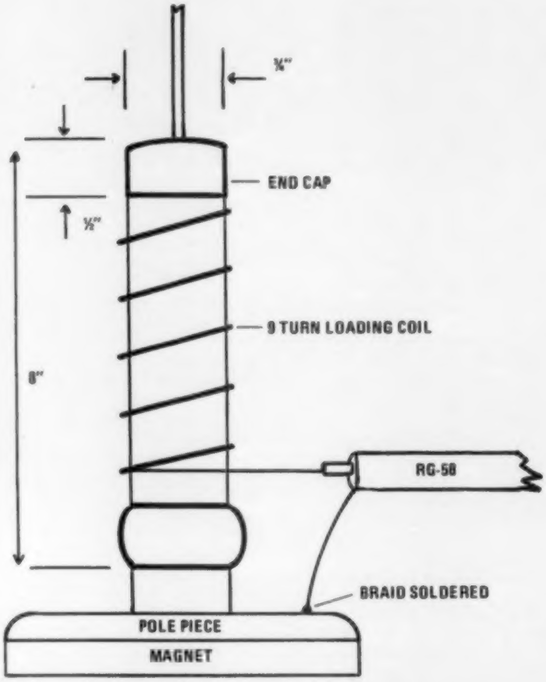


Fig. 1. Loading coil and base.

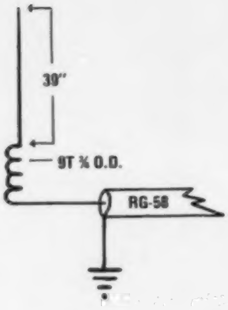


Fig. 2. Schematic diagram.

out a heavy coathanger in a vise and soldered it to the top cap. The coil assembly is now either soldered or epoxied to the metal base.

Finally a 14 foot length of RG-58 coaxial cable is connected to the antenna, with the inner conductor soldered to the bottom end of the loading coil. The outer braid is soldered to the pole piece with a large soldering iron. Alternatively, a hole could be drilled and tapped in the pole piece. The braid is then secured by means of a screw and lock-washer. As a final step, the exposed braid and inner conductor are sealed with silicone RTV to prevent water from seeping into the coax.

Tune-up

The completed antenna is now placed on a car roof or other large piece of sheet metal and the radiating element trimmed for lowest vswr. If a vswr meter is not available, cut the antenna to 39 inches in length, and as long as reasonably low power levels are used, the antenna should perform well. A good rule of thumb when testing any home brew antenna is to make sure that it receives correctly. Check it with an ohmmeter before firing rf into it.

Conclusion

Antenna mounted on top of author's 1960 Chevrolet.

My antenna, powered by the one Watt from a TR-22 and placed atop a 1960 Chevy, produced truly spectacular results. The WR1ABV machine in Boston could be hit solidly while driving through southern New Hampshire, at an airline distance of over 40 miles. Operating stationary mobile from Easton, New Hampshire, it was possible to hit the WR1AEA machine in northern Vermont with good results, a total air distance of 60 miles. I hope this antenna works as well for you as it has for me. Happy mobiling. ■

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A 15.75 kHz Oscillator

- - simple TV test unit

This is to describe a device of considerable value to the many hams that service TVs either in the shop or at home. It has not, so far as I am aware, been used or suggested by anyone else. It is simply a regenerative receiver set on 15.75 kHz, the TV horizontal oscillator frequency.

With it the horizontal oscillator frequency can be set correctly without a signal and the adjustment made in seconds without any doubt as to whether to increase or decrease the oscillator frequency. Many of us have spent valuable time in the shop blindly turning the slug in and out without the slightest idea where it should be for the correct frequency. If the oscillator is not working, there will be no signal regardless of adjustment. Adjustment of the horizontal oscillator in the usual manner only brings the frequency near enough that the sync pulse can lock it in step and thus is no assurance that in the free-running state it is on frequency.

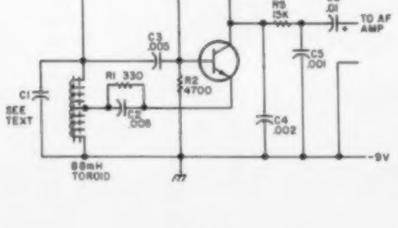

Fig. 1.

This receiver may be built into any small case such as that from a defunct transistor radio. Its variable condenser, audio amplifier and speaker may also be used if good. It may be made small enough to carry in a shirt pocket on house calls.

It is a simple project for you who are hams, but maybe not for those who only replace parts and consider radio a mystery. Not being entirely satisfied with the unit I have used for the last several years, and with this write-up in mind, I built another, per Fig. 1.

To conserve space and avoid hand capacity effect, an 88 mH toroid coil was used rather than a regular horizontal oscillator coil which would have required some shielding.

This circuit using the collector at ground potential for rf was chosen to simplify the audio takeoff. R5C5 provides additional filtering to keep rf out of the audio output. Use the audio amplifier in the original case, if convenient. If you must build your own, a small IC is suggested for compactness.

A regenerative receiver is most sensitive when not oscillating at full strength, so it is a good idea to use variable resistors to determine the best values for reliable but not excessive feedback, replacing them with the nearest fixed small resistors. While I used a 2N706 transistor, it is safe to assume that at least a hundred other types, requiring different bias resistors, etc., may do as well or even better.

C1 is made up of one or more fixed mica condensers in parallel with a small variable condenser or mica compression trimmer; the latter is definitely second choice. The total capacity required should be around .0018. Marked values are seldom correct. Temperature sensitive condensers are to be avoided for tuning. Silver micas are preferred. The temporary use of an external variable condenser of considerable capacity will expedite finding the proper value and frequency.

With this receiver's antenna near the horizontal area of an operating TV, listen for the 15.75 kHz signal when you are sure the receiver is oscillating. When zero-beat is obtained, with final tuning condensers in place in the final assembly, no further adjustment is required and it is ready for use.

With no signal or antenna on the TV to be serviced and with front panel control, if any, set at midrange, adjust the horizontal slug for zero-beat with the receiver and you are finished with that part of the job – no guesswork! If the sync doesn't take control, then that is a different problem, and there is no need to twiddle with the horizontal oscillator. ■

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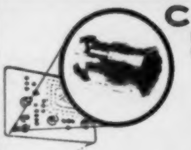

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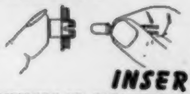

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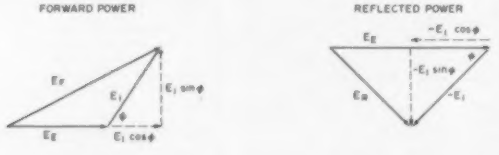
Behavior Mod for the HM-102

-- pretty simple

The Heathkit HM-102 swr bridge and power meter is an excellent swr indicator, and as an rf wattmeter it gives good results when the line in which it is used is a perfectly matched 50 Ohm line. Obviously this condition, if it occurs at all, will be present at only one specific frequency in a band, if the load is an antenna. The usefulness of the HM-102 as a wattmeter is therefore restricted by the fact that readings depart radically from true power if the swr in the 50 Ohm line is significantly different from unity. Furthermore, even in a matched line of some other impedance, the indicated reading is not true power being delivered to the load, but is so-called "forward" power from which "reflected" power must be subtracted to give a true power reading.

The HM-102 as assembled per Heath's instructions makes no provision for reading reflected power. However, it is possible with the rearrangement of a few components, some very slight surgery on the circuit board, and the addition of one .001 uF capacitor to provide for reading reflected power as well as forward power with the HM-102. This makes it possible to use it to determine the true power delivered to a load, regardless of swr or mismatch, on lines of any impedance.



$$E_F{}^2 = (E_E + E_I \cos\phi)^2 + E_I{}^2 \sin^2\phi$$
$$= E_E{}^2 + 2\,E_E\,E_I \cos\phi + E_I{}^2$$

$$E_R{}^2 = (E_E - \cos\phi)^2 + E_I{}^2 \sin^2\phi$$
$$= E_E{}^2 - 2E_E E_I \cos\phi + E_I{}^2$$

$$E_F{}^2 - E_R{}^2 = 4E_E E_I \cos\phi$$

Fig. 1. Vectorial addition of E_E and E_I in the forward power case, and of E_E and $-E_I$ in the reflected power case. The squaring is performed by the meter scale calibration, and the difference between the two scale readings is proportional to EI cos ϕ, the true power being delivered to the load.

Principles of Operation of the HM-102

In the HM-102, as in all typical directional rf wattmeters, the meter deflection for forward power or for setting swr sensitivity is proportional to the vector sum of two voltages. One of these is derived from and is proportional to the rf voltage on the line. The other is proportional to the rf current flowing in the line. With the swr sensitivity switch pulled "out" in making swr readings, these two voltages are in phase with each other if the load seen by the meter is resistive. With the swr sensitivity switch pushed "in," the phase of the voltage derived from the current is reversed so it is subtracted from the other voltage. The process of nulling the swr indication during initial calibration with a 50 Ohm load is actually the setting of the rf voltage sample exactly equal to the current sample. This is indicated by the null, since the two are exactly out of phase.

Now let's go back to a real fundamental of electricity. The true power being delivered past a point on any line is EI cos ϕ, where ϕ is the phase angle between the current I and the voltage E at that point. This is true whether we are dealing with dc, 60 Hz, or rf, regardless of mismatch, line impedance, or anything else. So in order to determine true power under any conditions, we need to measure this quantity.

For such a general case, the voltage derived from the current sample may have any phase relationship from -90 degrees to +90 degrees with the voltage sample, and their relative magnitudes may vary without limit. In the HM-102, meter deflection is proportional to the result of adding these two samples vectorially. The scale is calibrated to give an actual reading proportional to the square of this resultant.

This general case is shown in Fig. 1 for "forward" and "reflected" power. The rf voltage sample is represented by E_E, the voltage from the current sample by E_I. Their vectorial sum is designated as E_F in the forward power case and as E_R in the reflected power case, in which the polarity of E_I is reversed. As Fig. 1 shows, the arithmetic difference between the two scale readings is proportional to EI cos ϕ, which is true power flowing toward the load. We don't need to worry about the quantity "4" in front of EI cos ϕ. With a 50 Ohm resistive load, and with E_E and E_I set equal to each other, the normal calibration of the meter is done so that the correct power is indicated for the quantity $(E_E + E_I)^2$. This exactly equals $4E_EE_I$, so as you can see, the constant "4" is taken into account in the initial calibration, with or without the modifications we are talking about.

Circuit Modifications

From all the foregoing, it is evident that to read reflected power with the HM-102, we need a way to read $E_R{}^2$ by reversing E_I when using the power metering positions of the function switch, as we do when reading swr. It turns out that this can be done using the existing swr sensitivity switch to perform this function.

The original HM-102 circuit is shown in grey in Fig. 2 and the circuit after modification is shown in black.

The changes are made as follows:

(1) Remove the 100k resistor R3 from the circuit board and re-connect it in the meter unit from terminal 5 of the sensitivity switch to ground. Also connect a new .001 uF across R3 in this new location. Move .001 uF capacitor C14 to the location previously occupied by R3.

(2) Remove 82k resistor R9 from the circuit board and re-connect it between terminals 3 and 4 of the function switch in the meter unit.

(3) With a sharp knife or razor blade, break the foil connection on the circuit board between terminal 1 of R6 and the nearby end of R4, removing a small segment of foil. Leave enough of the foil coming from R4 to drill a small hole through it. Move the white lead from the interconnecting cable to this new hole instead of point B where it was originally connected.

(4) Move the red lead of the cable from point G on the circuit board to point B where the white lead was originally connected.

(5) In the meter unit, move the red lead of the cable to terminal 5 of the sensitivity switch.

That's all there is to it. Now the meter will read forward power on either scale with the swr sensitivity switch pulled out, and reflected power with the switch pushed in. True power is the difference between the two readings. The sensitivity control itself has no effect on the power indications when the function switch is set to measure power.

The calibration process and the use of the meter for swr readings are unaffected by these changes. Just be sure the sensitivity switch is pulled "out" for the power calibration! ■

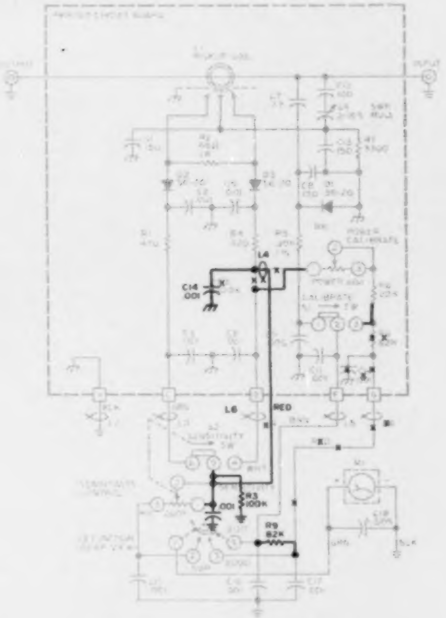


Fig. 2. Notes: 1. All resistors are 1/2 Watt 5% unless otherwise noted. Resistor values are in Ohms (k = 1000). 2. All capacitors less than 1 are in uF; greater than 1 are in pF. 3. Function switch shown in 200 position. 4. Calibrate switch shown in CAL position. 5. Sensitivity switch shown pushed in. 6. ⏊ This symbol indicates circuit board common. 7. ⏚ This symbol indicates chassis ground. 8. ☐ This symbol indicates an external connection to the circuit board. 9. ⊸ This symbol indicates a ferrite bead. 10. Overlay indicates circuit modifications.

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75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
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Antenna Magic

--good advice on antenna fundamentals

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You have just taken your Novice exam and are eagerly awaiting the arrival of your ticket so you can make that first contact. The piece of wire that is hanging out your window for your receiving antenna will not be the answer for your transmitter's sky wire. So, what are your alternatives? There is a confusing array of antennas available commercially at a variety of prices and hundreds of articles have been written concerning the construction of everything from dipoles to log periodics. I found myself confronted with this situation thirteen years ago and since then have had considerable experience with simple but very effective antennas, and have made thousands of enjoyable contacts both local and DX utilizing these antennas and low power.

Some Basics

First of all, the use of high power is unnecessary. Most Novices cannot wait to buy that kW amplifier so they can have a "big signal." However, if you look at the dB gain in increasing power from one level to another using the formula gain in dB = 10 log P_2/P, you will find that going from 75 Watts to 1000 Watts results in a gain of only about 11 dB. This is less than a two S unit gain at 6 dB per S unit. Granted that this may be significant when chasing rare DX or under adverse conditions, but the majority of your contacts will take place in more favorable situations. So, to communicate effectively, an effective radiating element is imperative.

The Vertical

When I received my license, I purchased a vertical antenna to go along with my fifty Watt Viking Adventurer transmitter. I ground mounted the antenna and drove a six foot ground rod about a foot from the base in accordance with the instructions. In attempting to make my first contact, my worst fears were confirmed. The story that vertical antennas radiated equally poorly in all directions was true. I thought that there must be something to improve the effectiveness of this convenient antenna and there was. Whether you purchase a commercially made vertical or construct your own quarter wave antenna, a good radial/ground system is an absolute necessity whether ground or roof mounted. I found that at least three quarter wave length radials for each band either lying on top of the ground or buried a couple of inches will not only lower the swr considerably, but also vastly improve the radiation effectiveness. Using the formula, quarter wave length =

$$\frac{234}{\text{Freq. MHz}}$$

the radial and antenna length for the Novice bands will be: for 80 meters, 63 feet; 40 meters, 33 feet; 15 meters, 11 feet; and 10 meters, 8 feet.

If a multi-band trap vertical antenna is used, adjust each section for the lowest swr, starting with the highest band. Be sure the ground radial system is connected during the adjustment phase to insure an accurate swr reading. Although it may take time to perform these adjustments, eventually a point will be reached where a low swr will be found on each band. In observing the operation of many verticals, they seem to perform better on the ground with a good radial system than on the roof.

The use of the vertical has proven itself for me over the years and I have worked over one hundred countries running no more than 180 Watts. The small area that this antenna occupies and the relatively low cost puts this antenna at the top of my list for permanently affixed antennas.

The Ubiquitous Dipole

I have been in several situations where it was impractical to install my vertical after initially arriving in an area, and in order to get on the air, I have used a dipole. I am currently using my "portable dipole" with good results on 40 meters. When I put my rig on the air at my Rocky Mountain QTH this past January, there was four

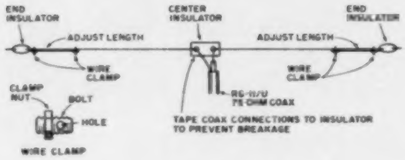

Fig. 1.

feet of snow on the ground. That slight inconvenience prohibited the installation of the vertical. This dipole has been used in various locations with equally good results.

Using the traditional formula for a half wave dipole, total length in feet =

$$\frac{468}{\text{Freq. MHz}}$$

the antenna can be constructed easily and very inexpensively. The higher quality RG11 coax (75 Ohm impedance) is recommended to feed the antenna to increase the transfer efficiency.

If the antenna is to be used as a "portable antenna" as is the one I have constructed, I have devised a simple method of tuning since the characteristics vary according to height above ground and its proximity to obstacles. This method can be used for adjusting the antenna from one band to another or changing the resonant frequency within the band. Using two small wire clamps (available at hardware stores) on each end of the dipole (see Fig. 1), the length of the legs can be varied. Using an swr bridge after setting the length employing the half wave formula, the antenna can be resonated for maximum efficiency. Since the antenna is never cut, the antenna can be lengthened or shortened at any time without having to solder additional lengths of wire to the existing antenna.

I have used this design on 40-10 meters and occasionally add fan elements to the center insulator to allow multi-band operation. I am currently using this antenna on 40 meters and it is only 20 feet above the ground at the highest point and is surrounded by pine trees. I have no trouble working almost everything I hear on 40 SSB and have worked into Europe, South Africa and the Pacific on 40 CW running 180 Watts from Colorado. This antenna was used as a hidden antenna mounted under the eaves of the roof of the bachelor officer quarters when I was in the Air Force and it performed well. Balun feed as well as direct coax coupling has been tried and the difference in performance was negligible. The balun would help reduce TVI if you are in an area where that is a problem.

Conclusion

Ham radio can be just as enjoyable running low power and using simple antennas as in using a beam and a kW. In fact, there is a greater challenge in using simple but efficient equipment. There is always a thrill when working a DX station under these circumstances. Do not let the antenna be the weak link of your station. Take your time in constructing your antenna and insure it is resonant to the frequency you prefer to operate. It does not have to be high in the air if it is well matched. I used a dipole only three feet above the ground in KL7 land for several weeks and had no trouble getting out.

It is not only inexpensive but very interesting to experiment with simple antenna designs. Do not let that rig sit idle for want of an antenna system. See you on the air! ■

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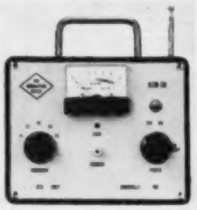

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Monitor scopes are still regarded as luxury items by many amateurs, even by those operating SSB equipment. This perhaps explains why there are many distorted SSB signals on the air.

Cor Hagoort VK5YH
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- - build a sideband monitor scope

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Transmitter:
2. 160 and 80m
3. 40 and 20m
4. 15 and 10m
5. 6m

A 3BP1 cathode ray tube was used, although a DG 7-5 is to be preferred because it is physically smaller and the internal electrode connections are shorter.

To obtain sufficient brightness, about 800 V EHT is needed. A transformer from an old 6 V vibrator power supply was used. This transformer has a 300 V secondary; the center-tap was not used, and, with a full wave voltage doubler, -840 V EHT was obtained.

The HT needed for the EF91 Miller-transitron sawtooth timebase generator is taken from the -420 V point of the voltage doubler, filtered and reduced to -330 V. The anode side of the EF91 has to be grounded to enable the use of this negative voltage.

This system necessitates the use of a 6.3 V filament winding which should be left floating. The 6 V vibrator primary yielded 8 V, which was reduced to 6 V by means of a 6.8 Ohm 1 W resistor.

Flyback suppression is achieved by taking a negative pulse from the screen of the EF91. This pulse is limited by the OA210 and the resulting flat-topped waveform fed to the grid of the 3BP1 to blank the retrace of the timebase sweep.

Horizontal deflection is controlled by the 1 M linear pot marked "HOR." Vertical deflection is controlled by the 500 pF tuning capacitor. An OA81 germanium diode was used for detection of the horizontal sweep, because there was one in the junk box, but an OA91 would be preferable.

Due to the fact that the horizontal plates D3 and D4 are more voltage-sensitive than the vertical plates D1 and D2, the trapezoidal pattern appears slightly pulled out vertically. In practice this does not matter very much.

The trapezoidal pattern can be reversed, by reversing the polarity of the OA81.

Connecting the Scope to the Receiver and Transmitter

Coaxial cable must be used for these connections.

Receiver

Connect a 5 pF capacitor from the plate of the last i-f tube to the inner conductor of the coax lead.

Transmitter

Mount a 1 turn loop near

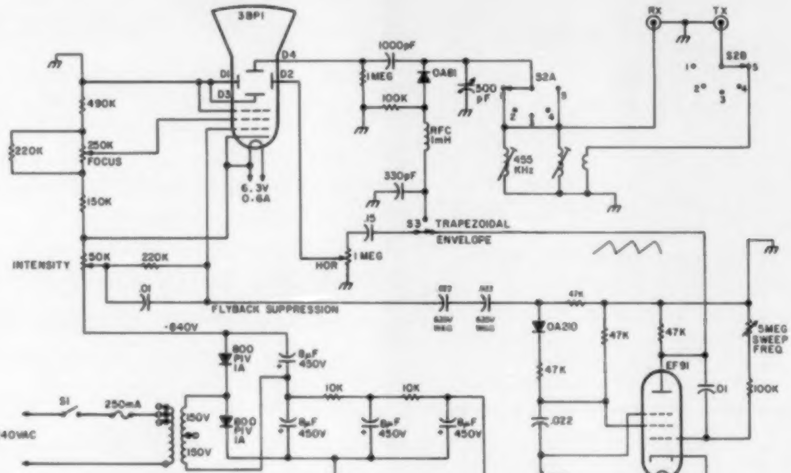

Fig. 1.

Reprinted from *Amateur Radio*, Journal of the Wireless Institute of Australia, October, 1974.

The monitor scope can be seen on top of my allband phasing rig.

the cold end of the PA tank coil and bring the signal out through a piece of coax cable.

Construction Hints

Do not mount the power transformer next to the CR tube. The transformer's magnetic field will influence the electron beam. It is better to mount the transformer behind the CR tube. The layout is not critical. One important point is to mount the 500 pF tuning capacitor with its associated circuitry as close as possible to the 3BP1 base. By keeping the connections between D4 of the 3BP1 and the tuned circuit as short as possible, this monitor scope will work up to 80 MHz.

Preferably, the CR tube should be shielded with a mu-metal shield. I must confess to once making a 144 MHz monitor scope using a DG 7-5 without a shield. It worked OK!

Information on the Coils in the Rf Section

Coil 1 is an i-f transformer with one coil shorted. The other coil is used with the fixed capacitor, which is normally soldered across it, removed.

Coils 2, 3 and 4 are slug-tuned. They are omitted from the circuit diagram for clarity.

Coil 5 is a hairpin loop.

All are link coupled, except the 455 kHz coil.

Note

If a DG 7-5 or some other CR tube is used, the EHT resistance chain should be altered to supply the correct voltages to the CR tube. ■

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The Hidden Charger

- - simplest charger yet

All right, all you fellow part-time home brewers, this is it. You have all seen the basic charging circuits before, as used in the textbook versions of "the-fundamental-way-to-charge-nicads" type diagrams. Well, this charger is little different except for one or two "convenience and/or safety" features. Just like the title states: This is an inconspicuous charger – plain and simple.

It is said that necessity is the mother of invention and my necessity was to save money! I'd just purchased one of the popular 2 meter hand-held portables and was determined not to shell out the extra twenty bucks or more to buy the accessory charger. After consultation with friends over a few beers, the simple circuit shown in Fig. 1 took shape.

In my particular case it so happened that I was fortunate enough to have an extra set of 10 AA nicads, and so, rather than have the HT sit in a charger for hours on end, I settled on a more convenient solution. I chose to charge one set at home while using the other in the field. Since I operate FM almost exclusively at this time, my "shack" is just about nonexistent. This meant that the charger would have to sit somewhere in the house. With this intent in mind, I conceived the "hideaway" design.

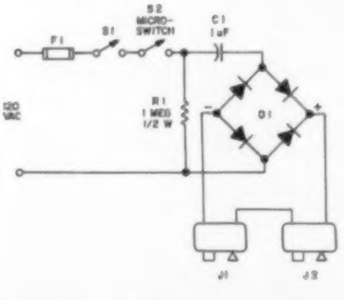

Fig. 1. Charger circuit.

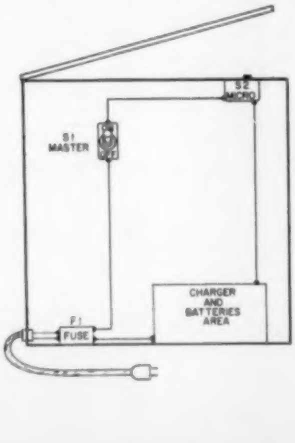

Fig. 2. Block diagram of basic layout.

A quick glance at Fig. 1 will reveal the circuit strategy. The details are rather straightforward. The circuit trickle charges the batteries at 40 milliamps which, in the case of my 450 milliamp hour batteries, was quite acceptable. Some who look at the circuit may balk at the high voltage that appears to be applied to the batteries, but this particular circuit is a variable voltage, constant current charger. Through the loading action the circuit voltage adjusts to the total voltage of the batteries being charged (12 volts in my case).

The charging current, however, is the variable and critical factor. In the case of constant current trickle charging, 450 milliampere hour AA cells should not be charged at greater than 45 mA. Elaborate current regulation could be employed here, but for the sake of simplicity and cost the current regulation in this charger is accomplished through the action of C1. It would seem logical then that C1 should be the highest quality and therefore the most expensive component of the charger. I used a 1 microfarad tubular capacitor that I had in the junk box, but a higher quality capacitor should be used (no electrolytics allowed). The 1 microfarad capacitor regulates to about 40 milliamps of charging current. As a matter of fact, the charging current increases by 4 milliamps for every .1 microfarad of capacitance used (hence 1 microfarad = 40 mA). This variance allows you to choose the right charging current for your need, but remember to stay under your particular charging current limits!

No elaborately filtered dc

is needed for charging, so the full wave rectifier (D1) was chosen to do the job. Just about any cheap little full wave package will do, as long as it is rated high enough. I used a package rated at 200 volts at better than ½ Amp. The resistor R1 is included as a bleeder for C1.

The rest of the circuit is a combination of my love for gadgetry and my previously stated desire for an inconspicious charger. I finally decided to install the entire unit in an old teakwood box that would halfway blend into most rooms.

The actual circuit itself (except for switches) was mounted on a breadboard chip which was placed in a small utility box that sat at the bottom of the teakwood enclosure. The batteries (along with J1 and J2) were simply allowed to lay on the bottom of the enclosure near the utility box itself.

I also didn't want curious souls opening the box while it was in operation and exposing themselves to possible shock. This is where S2 comes into play. S2 is a microswitch, of which I happen to have quite a few. I mounted the microswitch near the top so that closing the lid of the box closed the switch as well. In this configuration the circuit will be deactivated whenever the lid is raised (see Fig. 2). S1 is the master switch (optional), and it occurred to me as I was composing this article that a light bulb or LED indicator could be added. Remember, though, that the circuit voltage will vary from 120 V with no batteries attached to 12 V while charging. The indicator will have to be designed to compensate, of course. For added safety, all exposed wiring should be well covered.

The other minor details concern F1, J1 and J2. F1 is a little bit of extra safety to guard against the results of any accidental shorting. The fuse value is not given here since it will vary for most modifications of the design. Each builder should choose a value to suit his own needs.

J1 and J2 are inexpensive 9 volt battery clips. I used these as a cheap solution to the accidental reverse polarization problem. I decided to load the 10 AA batteries into one 4 cell plastic AA battery holder and another 6 cell AA plastic holder. I purchased the type of holders that sport the mating terminals for the J1 and J2 clips. They are available at just about any local electronics emporium. Note that they are wired in series. This is necessary for each holder set of batteries to get a full charge. It would take a real klutz to try to match the female terminals to female (or male to male), so the possibility of incorrect polarization is reduced somewhat!

A few words on the characteristics of the charger itself would be appropriate here. Do not leave the batteries connected to the charger when the unit is not in operation, since the internal resistance of the charger has a tendency to drain the batteries. Also, this charger is a trickle charger, so about 16 hours of charging time works out rather well. As a matter of fact, the batteries can be left charging longer than 16 hours, but such prolonged charging could develop a "memory" in the cells for a particular level of charge which the batteries will not exceed.

Well, that about wraps it up except to say that this charger article is simply a detail of how I happened to solve a particular problem in a particular way. It is absolutely wide open for experimentation and modification. The urge to modify flows in the blood of most hams, and by the time this article is printed I will have probably already changed the circuit beyond recognition! ■

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73 Magazine *Staff*

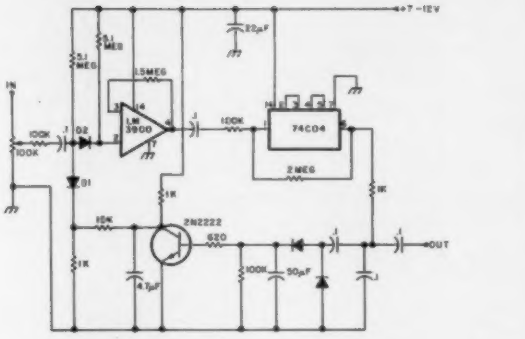

Fig. 1. Complete expander/compressor. Diodes are 1N914s.

All broadcasting stations employ some device to limit their maximum modulation level — usually a peak limiter. But besides this device, many also employ further speech processing equipment to keep the average modulation percentage as high as possible to achieve maximum effective coverage with the allowed transmitter power level. This means money to the station, and so speech processing equipment can be quite sophisticated and expensive; present solid state units cost about $800. These units perform two main functions: expansion and compression of the audio used to modulate the transmitter. With very low audio input levels, expansion is used to bring up the audio level. When the audio input level reaches a certain point, expansion ceases and then compression takes place as the audio input level increases further.

Almost all amateur type speech processing devices provide a compression function only. This simplifies the circuitry but it has several disadvantages. If one suddenly speaks at a lower than normal level, compression may not take place and the advantage of the speech processing device is lost. If one sets the gain of the compressor so high that compression takes place even with the lowest possible voice level, there will be a great deal of noise in the background and a particularly great noise buildup can develop between speech pauses, depending upon the time constants involved in the circuit that is used.

Building a compressor with an expansion feature also normally would involve complicated circuitry, but a circuit recently appeared (*Electronics*, August 7, 1975) which has greatly simplified the building of such an expander/compressor for amateur usage with any mode of voice modulation. The original circuit was designed for processing touchtone signals. This article describes the circuit and some modifications to it so it can be used for speech processing. The circuit uses only two inexpensive ICs (total cost about $1) and operates from a single supply voltage source of from 7-15 volts. It can, therefore, be battery-powered as a separate unit or housed inside an existing transceiver. In fact, with a little care in construction, it could even be built in the case of most mobile microphones and powered by a miniature 7.5 volt mercury battery every time the PTT button was activated.

The circuit is shown in Fig. 1. The circuit consists of two amplifier stages. The gain of the first stage is variable while the gain of the second stage is fixed. Some output is rectified and used to drive a 2N2222 which in turn varies the gain of the first stage. The neat little trick that is used to allow both an expansion and compression function centers around the biasing of diode D1. The bias on this diode is controlled by the 2N2222 stage. When the output signal of the fixed gain stage is low, the 2N2222 stage is not driven very hard and D1 becomes back-biased. Current flows through R1 into the non-inverting input of the first amplifier stage and its gain increases. As the output of the fixed gain amplifier increases, the 2N2222 is driven harder and D1 becomes more forward-biased. Current through R1 is diverted to ground instead of

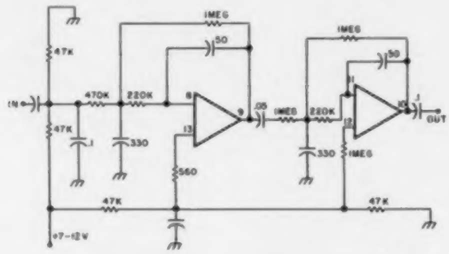

Fig. 2. Two stage low pass audio filters. The op amps are unused sections available in the LM3900 IC of Fig. 1.

to the op amp input and the gain of the input stage is reduced.

The input stage uses a conventional LM3900 op amp. Actually, there are four complete op amps in the IC although only one is used in this application. The input is for a medium to high impedance microphone. Very low impedance microphones will require a preamplifier stage both to raise the output level and to work into the expander/compressor. The 100k potentiometer is used to set the input level so with a normal speech level the unit is in its compression range. This can be checked by a listening test, or better yet, by using a scope to see that the output level of the unit remains constant at the highest setting possible of the input potentiometer. The highest setting possible is that just before the unit is driven so hard that the output clips and becomes distorted.

The second fixed gain amplifier stage actually uses a digital IC – the 74C04 hex inverter. Three of the inverting amplifiers in the IC are wired in series. The other three are unused. Linear operation of the IC is achieved by biasing the inverting amplifiers to the center of their linear range. Part of the output from this is rectified and filtered to drive the 2N2222 stage. The 50 mF capacitors in the base circuit of the 2N2222 and the 4.7 mF capacitor in the collector circuit determine the time constants involved. One may wish to do some experimentation with these values for optimum attack and release times. These values were changed from the original circuit to provide what sounded to be the best results for speech purposes.

A still further refinement can be added to the unit by utilizing the unused op amplifiers in the LM3900 as low pass filter stages. The main advantage to doing this is that in case the main stages are over-driven so they start to clip, the low pass filter stages will filter out some of the harmonics which are generated. The audio signal will still sound rough but at least severe distortion will be avoided.

The circuit of the low pass filter stages is shown in Fig. 2. The time constants are such that rolloff starts around 3500 Hz. The output level is in the order of ½ volt. A potentiometer (100k or higher value) may have to be used to control the output if the level is too high for use with an existing transmitter.

All in all, the circuit provides a worthwhile speech processing advantage with extreme circuit simplicity. With an op amp and three hex inverters left over (even with the low pass filter option added), one could probably add a tone encoder function and/or VOX function also if desired. Quite a lot for $1.00 worth of ICs! ■

Looking *West*

from page 16

dealing with FCC Chief John B. Johnston's appearance before the southern California amateur radio community. We have spent two columns telling you, thanks to the magic of magnetic tape, what John had to say to us. Now I wish to take a bit of editorial liberty and talk about how I interpreted what he said and what I feel is the best direction for us to travel in working with this fine man.

First, John can only act in our behalf if he knows what we want. This takes a constant flow of information from within the amateur community into his hands and those of his staff. Remember, though, that if you intend to write John because you see something that might affect the continued viability of amateur radio, it is not enough to sit and write criticism. Criticism brings with it a rather specific obligation to provide an alternative, another direction to follow or other specific ideas to back your point of view. Anyone can easily say "I don't like that" or "I don't like that because we can't do it" or even "You're crazy; go soak your head." The aforementioned takes virtually no intelligence and only the most gut level animal instinct. However, to sit down and analyze a given piece of pending legislation as an adult, to view it not only from a personal and thereby somewhat selfish standpoint, to, far more importantly, look at how any given proposal will ultimately affect all amateurs and amateur radio itself, and from this to formulate a reply that is constructive, is the obligation of anyone who decides to offer any form of official comment.

Awards that amateurs can "win" are described by Mary and Ed Kellitz WA6EJP. ATV at left was also described that evening by an ATV expert.

This, then, means that before you sit down to write it might be wise to discuss your views with others to see how they feel and if they can offer any input by way of comment or suggestion. By doing this, you then not only represent your views, but perhaps a cross section of your area's total amateur population. One of the best places I know to hold such discussions and thereby formulate replies to dockets issued by the Amateur and Citizens Division is at a local radio club. In fact, when an issue arises that calls for comment, one of the best ways that I can think of to get some attention for your point of view is to have a radio club behind you. One of the things that John is looking for is "commentary that is well prepared and representative of the majority of the amateurs of a given area, organized commentary of the type that not only offers either backing or criticism, but alternatives as well."

I tend to look at the radio club as the hometown grass roots political organization. It is one of the few forums we have other than talking on the air, and as such has a lot to offer. If you do not now or never have belonged to a radio club, but are getting the bug to take a more active role in helping plot the future course of the amateur radio community, that's really where it all starts.

In my book we have one heck of a good guy representing us to the Commission in FCC Chief John Johnston, but to be totally effective he needs to hear from us and get our ideas once in a while. While I might not agree with everything that he places before us in docket form, at least I know that he will take the time to read my comments and yours and base any final legislation on our needs, doing so to the best of his ability. I can ask little more. I can, though, wish him continued success in what must be one tough job.

73 Magazine Staff

Measure Your Wasted Power

- - how much are you losing in your feedline?

Transmission line attenuation is one of those items which most amateurs, especially newcomers, realize is important but rarely do anything about. One reason for this feeling probably has to do with the fact that transmission line attenuations, when quoted in dB, don't seem very meaningful. That is, a transmission line attenuation of 2 or perhaps even 3 dB seems to have a less disturbing effect upon an operator than learning that the output of his linear amplifier has fallen from 1,000 W to either 500 or 620 W. Yet, the transmission line attenuations quoted would have the same effect as far as the *radiated* signal is concerned. Also, many operators go through a lot of work to construct new linear amplifiers in order to raise their power level by a factor of only 2 or 3 times. Yet, on the higher frequency bands where fairly long transmission lines are used, the same increase in effective *radiated* power can be nearly achieved by replacing a long run of RG58/U line with RG8/U line!

Table 1 shows the attenuation characteristics of the three most common types of coaxial transmission lines on the various amateur bands. These attenuations are for brand-new line without connectors. Even so, the losses start to become significant on the higher frequency bands. When one considers line that has become aged, and when connectors and other "lossy" devices are used in a transmission line, the total losses can rapidly add up to significant values even on the lower frequency bands. The buildup of such losses can take place over a period of time and so gradually that no apparent deterioration in either transmitter or receiver performance is noted. The buildup of such losses will not be indicated by the tuning meters on the transmitter, nor on the swr meter readings as long as the antenna remains correctly impedance matched to the transmission line.

Most amateurs realize to some degree the desirability of keeping line attenuation as low as possible, but rarely do anything more about it other than initially carefully installing line believed to be fresh. The reason why line attenuation is not periodically checked as it should be is the difficulty involved in making such measurements by conventional methods. Certainly, few amateurs would want to measure the power input to a line, dummy load the far end of the line, measure the rf voltage across the dummy load, calculate the power output, and then finally find the line attenuation. Various errors can be involved in making such measurements, and good test equipment is necessary for accurate results. Some years ago a method for line attenuation measurement was suggested using the technique of shorting the far end of the line to create a complete reflection of the incident power traveling down the line. By swr measurement at the transmitter, the line attenuation could be determined. The basic concept of the measurement technique was good, but there were several disadvantages for practical usage.

The measurement technique described in this article refines the technique by the use of a carefully chosen load to create an artificial swr. The result is a measurement technique that is particularly sensitive to even small changes in line attenuation and a method that needs only a regular swr meter to implement. Even the swr meters built into some equipment which are calibrated only up to 3:1 swr are satisfactory.

Basic Theory

One should be familiar with the theory behind the swr method of line attenuation measurement. The method is based on the fact

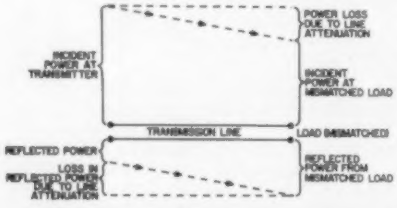
POWER LOSS DUE TO LINE ATTENUATION
INCIDENT POWER AT TRANSMITTER
INCIDENT POWER AT MISMATCHED LOAD
TRANSMISSION LINE
LOAD (MISMATCHED)
REFLECTED POWER
LOSS IN REFLECTED POWER DUE TO LINE ATTENUATION
REFLECTED POWER FROM MISMATCHED LOAD

Fig. 1. The effect of line attenuation as explained in the text produces different swr readings at the transmitter and load (antenna) ends of the line. Example: P(incident) = 100 W, line attenuation = 3 dB, load swr = 5:1. Incident power at load = 100 x ½ = 50 W. Reflected power at load = 50 x .445 = 22.25 W. Reflected power at transmitter = 22.25 x ½ = 11.12 W. Power ratio at transmitter = 11.12/100 = .1112 = 11% of incident. Swr at transmitter (from Fig. 1) = 2:1.

Nominal Attenuation dB, Per 100 Feet

Band	RG58	RG8	RG59
160	.6	.2	.5
80	.82	.3	.65
40	1.3	.45	.9
20	2	.5	1.4
15	2.5	.62	1.6
10	3	.8	1.9
6	4.1	1.4	2.5
2	7.8	2.5	4.0

Table 1. Attenuation of various coaxial transmission lines on 160-2 meters. These losses are for brand-new cable and do not include additional losses due to connectors, relays, filters, etc., used in the transmission line.

that the swr values for any value of swr other than 1:1 will not read the same at both ends of a transmission line — if the line has *any* attenuation whatsoever. This concept is illustrated in Fig. 1. The ratios of the incident and reflected power at any point along the transmission line are related to the swr that would be read at that point. Note that at the transmitter end of the line, the reflected power is only a small portion of the incident power while at the load (deliberately mismatched to create a specific swr), the reflected power is almost as great as the incident power.

This change in the ratio between the incident power and reflected power at the transmitter end of the line is directly related to the total attenuation of the line. The effect is such that the presence of even small amounts of attenuation can be readily determined. The sample calculation shown in Fig. 1 should be followed through once carefully in order to understand the principle involved. Table 2 is a simple listing of how much of the incident power is reflected at a *load* for a given swr at the *load* terminals. It must be used to understand the example shown in Fig. 1. The example itself shows what the swr reading would be at the transmitter end of a transmission line if the line had an attenuation of 3 dB at the operating frequency used, and if the load were mismatched to the transmission line such that a 5:1 swr existed at the *load*. As shown, the swr reading at the transmitter would read 2:1 and not 5:1 due to the line attenuation.

In the manner shown, one could calculate what the swr readings would be at the transmitter for any given *load* swr and various line attenuations. A listing of the results of such calculations for load swrs of 5:1 and 3:1 and various line attenuations is shown in Table 3. Note particularly how sensitive the swr reading at the transmitter is to even small line attenuation values. For example, for a 5:1 load swr, the swr reading at the transmitter would be 5:1 if the transmission line used had no attenuation. However, even a line loss of only ½ dB will cause the swr reading at the transmitter to be 3.9:1 instead of 5:1. The load swrs shown in Table 3 were chosen to be listed because, in practice, they are usually the most handy to use. They permit good indication of the range of line attenuations likely to be encountered in most installations, and the range of swr readings produced at the transmitter is within the range where most swr meters (including those built into transceivers, linears, etc.) can be clearly read.

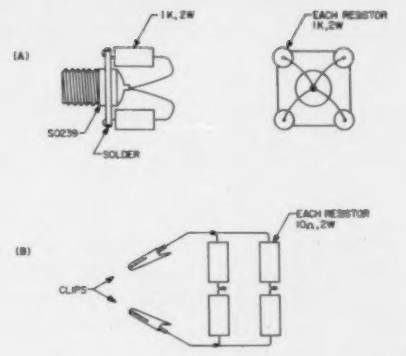

Fig. 2. Two resistor assemblies that may be used at the antenna end of a transmission line to create a given load swr for test purposes. The usage of each assembly is explained in the text.

Using The Technique

Using the technique just described to make actual line attenuation measurements is not at all difficult as long as a few precautions are observed. Any swr meter can be used, either a separate unit or one built into a piece of equipment, as long as swr readings of up to 3:1 can be calibrated. One must be *sure* of the calibration of the swr meter, or else the measurements made will be meaningless. The instruction book for most swr meters describes a calibration procedure. In any case, one can check the calibration by using 2 W carbon composition resistors directly at the swr meter, choosing the resistor values to simulate different swrs. For example, an swr meter meant for use in 52 Ohm transmission line can be checked for its 2:1 swr reading by using a 104 Ohm resistor (nominal 100 Ohm unit), for its 3:1 swr reading by using a 156 Ohm resistor (nominal 150 Ohm unit), etc. Usually from a batch of 10% tolerance resistors, one can find the necessary resistor values. If this cannot be done, or if a good ohmmeter is not available, 5% tolerance resistors in stock values can be used for calibration. In any case, non-inductive-type resistors should be used and the swr meter checked over the range of frequencies to be used.

Once one is confident that the swr meter calibration is correct, a resistor unit must be constructed to simulate either a 3:1 or 5:1 swr at the antenna end of the transmission line to be tested. One suggested method of construction is shown in Fig. 2(a). A grouping of four 2 W composition resistors is soldered directly on an SO-239 coaxial fitting for use in a situation where the transmission line used employs a standard PL-259 connector at its antenna end. The resistors are wired in parallel and chosen in the example shown to provide a 5:1 swr for a 52 Ohm transmission line system. The resistor unit can be checked that it provides the correct swr by connecting it directly to the antenna side of a calibrated swr meter. Usually if the resistors were carefully chosen beforehand using an ohmmeter, there will be no difficulty. Again, the resistor unit should be checked on all frequencies where it will be used to check line attenuation.

After everything has been calibrated, the far end of the transmission line is disconnected from the antenna and connected to the resistor unit. A few Watts of transmitter power are used so a proper "set" reading can be obtained on the swr meter at

swr	Incident Power Reflected (%)	swr	Incident Power Reflected (%)
10	67	2.5	18.3
9	64	2.0	11
8	60.5	1.9	9.6
7	56	1.8	8.2
6	51	1.7	6.7
5.5	48	1.6	5.3
5	44.5	1.5	4.0
4.5	40.5	1.4	2.8
4	36	1.3	1.8
3.5	31	1.2	.8
3	25	1.1	.2

Table 2. For a given swr at a load, the listing shows the percentage of incident power which the load does not accept and reflects back along a transmission line.

For 5:1 Load swr

Cable Attenuation, dB	swr at Transmitter
.5	3.9:1
1	3.3:1
2	2.45:1
3	2.0:1
4	1.7:1
5	1.5:1
10	1.15:1

For 3:1 Load swr

Cable Attenuation, dB	swr at Transmitter
.5	2.6:1
1	2.3:1
2	1.9:1
3	1.7:1
4	1.5:1

Table 3. Transmitter swr readings as a function of line attenuation for load swrs of 5:1 and 3:1.

the transmitter when it reads forward power. The meter is then switched to reflected power, the swr read, and the total transmission line attenuation determined using Table 3.

The method can actually be used in many installations without even disconnecting the transmission line from the antenna. If one knows that the antenna has been adjusted to provide a 1:1 match to the transmission line at the transmission line/antenna interface, it is only necessary to parallel the antenna terminals with additional loading to create a 3:1 or 5:1 swr. A grouping of resistors made up as shown in Fig. 2(b) might be used for this purpose. In this case, resistor values must be used which are lower in value than the line impedance, since they are placed in parallel with the antenna terminal impedance. As shown, four nominal value 10 Ohm resistors are grouped together and chosen to produce an overall resistance of 13 Ohms, which in parallel with a 52 Ohm antenna will provide an effective termination of 10.4 Ohms for a 5:1 swr. One resistor could possibly be used if the swr meter used at the transmitter were sensitive enough and only a few Watts of output power were necessary. The "clip-on" resistor unit can be checked, of course, by directly coupling it to the swr meter where, by itself, it should provide a 4:1 swr reading.

Summary

Many amateurs who check their transmission line attenuation for the first time are shocked at the values they discover, particularly on the higher frequency bands. One should realize that besides the transmission line itself, one will also be reading the attenuation introduced by the various relays, filters, switches, etc., used in the transmission line in more elaborate station setups. No matter what the attenuation is due to, however, it of course reduces the radiated power and the sensitivity of the receiving system (assuming the same antenna is used for receiving).

A periodic check of line attenuation will quickly reveal any developing problems. In installations where the antenna end of the transmission line is particularly difficult to get to, one might even consider installing a relay at the antenna so a test resistor unit can be selected to check the line condition whenever desired. Before the installation of any transmission line, its attenuation should be checked so one will then have some basis against which to evaluate later attenuation measurements made when the line is installed. ■

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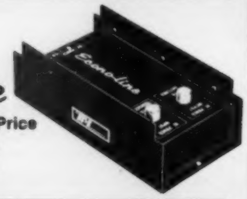

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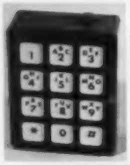

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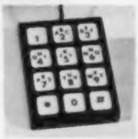

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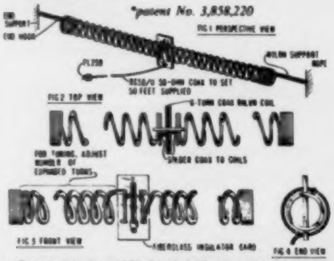

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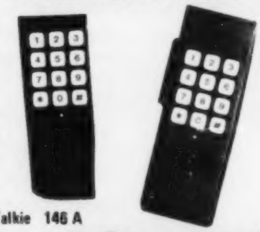

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New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

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* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

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Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—ldilg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.23'	.31'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 22' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.12 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK,	complete 4 element stacking kit
A14-SK,	4 element coax harness only
A147-VPK,	complete 11 element stacking kit
A147-SK,	11 element coax harness only
A449-SK,	6 + 11 element coax harness only

E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/20"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	48°	66°	48°	60°	48°
Wind area sq. ft.	1.23	.43	.39	.30	.99
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

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New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144 7	A144 11	A220 11	A430 11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	28 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

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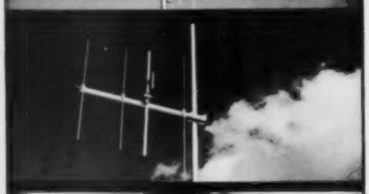

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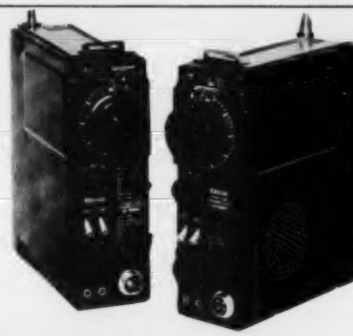
A147-22	69.50	AR-25	21.50
A220-7	18.95	AR-220	18.50
A220-11	22.95	AR-450	18.50
A449-6	15.95	ARX-2	28.50
A449-11	21.95	ARX-2K	11.95
AFM-4D	53.50	ARX-220	28.50
AFM-24D	49.50	ARX-450	28.50

Send SASE for a reprint of this catalog!

Now It's Crystal Clear

Yes, now ICOM helps you steer clear of all the hassles of channel crystals. The new **IC-22S** is the same surprising radio you've come to know and love as the **IC-22A**, except that it is totally crystal independent. **Zero crystals.** Solid state engineering enables you to program 23 channels of your choice without waiting. Now the ICOM performance you've demanded comes with the convenience you've wanted, with your new **IC-22S.** *Price: $289.00*



Hold it!

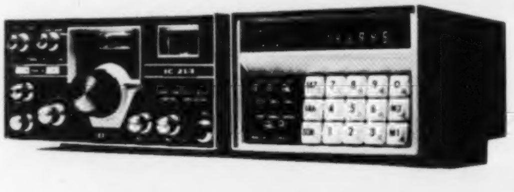
Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

Hello, DX! The ICOM quality and excellent receiver characteristics of this pair make bulky converters and low band rigs unnecessary for getting started in SSB-VHF. You just add your linear amp, if you wish, connect to the antenna, and DX! With the **202** you may talk through OSCAR VI and VII! Even transceive with an "up" receiving converter! The **IC-502,** similarly, makes use of six meters in ways that you would have always liked but could never have before. In fact, there are so many things to try, it's like opening a new band.

Take hold of Single Side Band. Take hold of some excitement. Take two.

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!
Price: $259.00

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!
Price: $249.00



IC-21A 146 MHz FM 10W transceiver — $399

DV-21 Digital VFO — $299.

IC-21A

- Low intermod, due to MOS-FET RF Amp and 5 helical resonator filter, plus 3 I.F. filters.
- IDC modulation control provides for minimum bandwidth and channel splatter.
- Virtually no intermod, due to MOS-FET RF amp and 5 helical cavities in the front end plus FET mixer and 3 I.F. filters.
- Variable output power. 10 watts output or another output between 500 milliwatts and ten watts may be selected by an external control.
- S.W.R. bridge, built right into the front panel of the IC-21A, is an accurate meter for VHF S.W.R. bridge. An invaluable aid in VHF antenna experiments!
- The IC-21A contains both the 117 V ac and the 13.6 V dc power supplies.

DV-21

- The perfect companion for your IC-21 or IC-21A, the DV-21 is a unique digital synthesizer to complete your ICOM 2 meter station. The DV-21 will operate in 10 kHz steps over the entire 2 meter band. It can also scan frequencies being used. Completely separate selection of the transmit and receive is as simple as touching the keys. Release the mic switch, and the receive frequency is displayed. There are also two programmable memories for your favorite simplex-frequencies. You won't believe the features and versatility of the DV-21 until you've tried it.
- Advanced feature of the DV-21 — the ability to capture 5 kHz split tertiary with a 10 kHz synthesizer. The 0.5 kHz offset provides the mean to get exactly on the frequency; but even in the scan mode, the channel may be scanned and understood.
- The DV-21 has its own built-in 117 ac power supply as well as the ability to operate from the 12 V dc line.

Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215** FM portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial / 3 priority)
- Fully collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter

Price: $229.00

Your new IC-215 comes supplied with: 5 popular channels; handheld mic, with protective case; shoulder strap; connectors for external power and speaker; 9 long-life C batteries.

ICOM

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

Matching speaker unit (3854) and complete external VFO (3855) also available.

See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

3854 – $50.95 3750 – $1895.00 3855 – $495.00

There is no substitute.

hy-gain®
Amateur Radio Systems.

Hy-Quad 10-15-20 Meter Antenna 3-bands, 2 elements, 1 package

Complete from Hy-Gain.

Now Hy-Gain wraps total 3-band quad performance into one tidy package. The Hy-Quad. Specially engineered to maximize unique quad advantages while minimizing inherent disadvantages. Exceptional Hy-Quad features include all-aluminum diamond element structure and single feed line that simplify line routing. Cycolac ® insulators break spreaders at strategic electrical points with each element individually resonated to prevent interaction.

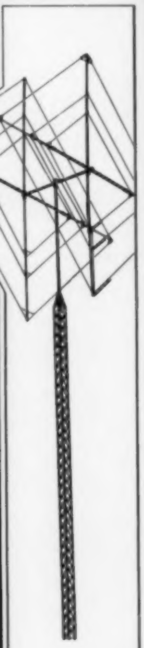
All Hy-Quad designs are thoroughly tested at Hy-Gain's 35-acre test site to insure continuous peak performance.

Hy-Quad. The unbeatable package deal. Complete from Hy-Gain.

- Individually tuned gamma matches on each band.
- Exclusive vertex feed.
- Full wave element loops require no tuning stubs, traps, loading coils or baluns.
- Horizontally polarized.
- VSWR less than 1.5:1 at resonance on all bands.
- Mounts on any mast 1-1/4 to 2-1/2 diameter.
- 52 ohms impedance.
- Accepts maximum legal power with ease.
- Boom length 8 .
- Spreaders 25 5 overall.
- Turning radius 13 6 .
- Weighs just 42 lbs. complete.

Order No. 244

hy-gain®
Amateur Radio Systems.



$219.95

MULTI-BAND HY-Q TRAP DOUBLETS

Hy-Q Traps

- **Install Horizontally or as Inverted V**
- **Super-Strength Aluminum Clad Wire**
- **Weatherproof Center and End Insulators**

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke...will not stretch...withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cycolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

CENTER INSULATOR for Multi-Band Doublets Model CI

Strong, lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ⅜" coaxial cable. Shpg. Wt., 0.6 lbs. $5.95
Order No. 155

PORTABLE ANTENNAS

Rugged, durable, continuously loaded antennas designed for portable applications. Constructed to withstand rough handling. Completely insulated with vinyl coating. Can be bent at all angles without destroying or cracking protective finish. Cannot be accidentally shorted out.

Frequency	136-470 MHz (specify model)
VSWR	2.0 to 1 or less
Loading Coil	Plated wire, silver solder, cad. plated brass base

Model 274 – $9.00 Model 275 – $7.00 Model 269 – $7.00

MODEL 280Q for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs. **$49.95**
Order No. 380

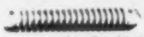
MODEL 580Q for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum legal power. Shpg. Wt., 12.2 lbs. **$79.95**
Order No. 383

BROAD BAND DOUBLET BALUN for 10 thru 80 Meters Model BN-86

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95
Shpg. Wt. 1 lb. Order No. 242

Hy-Gain SINGLE BAND DOUBLET Model HD-4

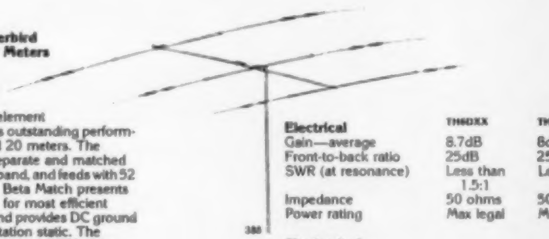
High performance single band doublet installs horizontally or as inverted V. Takes 500 watts P.E.P. Supplied with cutting instructions for 10, 15, 20, 40 or 80 meter operation. Complete with miniature center and end insulators, 50' RG58/U and necessary copper clad stranded steel wire. Shpg. Wt. 3.3 lbs.
Order No. 214



END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs $3.95 Order No. 156

Super 3-Element Thunderbird for 10, 15 and 20 Meters Model TH3Mk3



Price: $119.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	TH6DXX	TH3Mk3
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6DXX

Price: $239.95

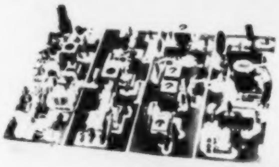
The Super Thunderbird TH6DXX offers the ultimate in tribander performance and mechanical reliability for 10, 15 and 20 meters. Separate Hy-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and readjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

Build a 2 meter or 220 MHz Transceiver

10 Channel Scanning . . . 15 Watt

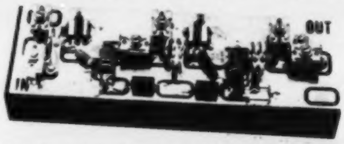
You can put it all together for only $219.95

RX144C or RX220C Receiver Kit



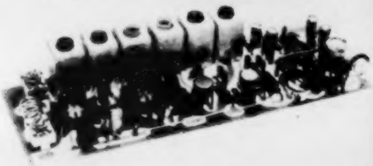
SENSITIVITY .3uV for 20db quieting. SQUELCH THRESHOLD .2uV. AUDIO OUTPUT 2 watts. STABILITY better than –.002. IMAGE REJECTION 60db. SPURIOUS REJECTION greater than 60db. IF REJECTION 80db. FIRST IF 10.7 Mhz. SECOND IF 455 Khz. BANDWIDTH 15 Khz at 3db, 60 Khz at 30db (40 Khz with optional 4 pole filter). CRYSTAL 45 Mhz parallel at 20pf (HC/25U holder).

PA144/15 - 15 Watt Power Amplifier

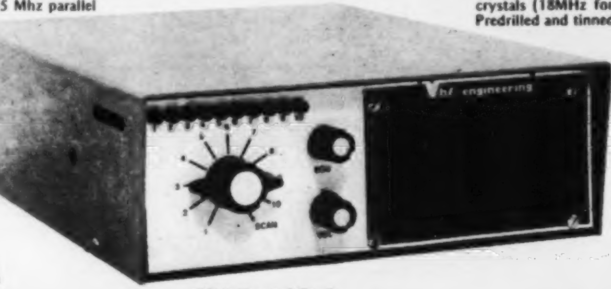


POWER GAIN; 12 db nominal, INPUT POWER; 2 watts max., INPUT VOLTAGE; 12 to 14 volts DC negative ground, INPUT CURRENT; 4 amps max., STANDBY CURRENT; virtually insignificant, INSERTION LOSS; less than 1 db on receive, DUTY CYCLE; 50% or less. Consists of drilled glass PC Board, heat sink and all components.

TX 144B or TX220B Transmitter Kit



A one watt exciter using four RF transistors, two diodes, and one integrated circuit. The RF transistors are operating well below their ratings allowing long keying periods without damage. • Nominal output 1½ watts • Deviation adjusted to 10KHz • IC audio with clipping and active filter • All spurious outputs down 30db or more • Temperature compensation crystal trimmer • Zener regulated oscillator • Uses readily available 12 or 18 MHz crystals (18MHz for 220) • All tuning coils prewound • Predrilled and tinned G-10 Circuit board



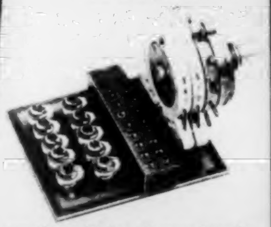
SC-3 Scanner

Capable of scanning up to 10 channels. Scan delay allows both sides of a conversation to be monitored without the scan starting each time the carrier drops. The priority feature allows the user to program the scanner to return to his favorite channel whenever it is active.

CD-1 Crystal Deck

A ten channel receiver crystal deck which utilizes diode switching to select the crystal position required.

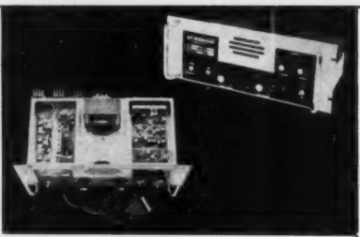
CD-2 Crystal Deck



Designed to provide multi-channel operation for the TX-series transmitters. It features an extra set of contacts that may be wired to the CD-1 crystal deck for 10 channel transceive. The extra contacts may also be used to switch L.E.D. indicators. The switch has 11 positions.

Complete with cabinet, speaker, hardware, L.E.D.'s, all accessories and full assembly instructions.

(Crystals and microphone not included.)



IF YOU ARE ON 144, 220 OR 432 AND HAVE WORKED A REPEATER...

It was probably this one.

The RPT 144B, RPT 220B and RPT 432 are self-contained — all solid state machines. Conservatively rated, high quality components, assures EXCELLENT RELIABILITY. Careful consideration has been given to both interfacing and control flexibility.

RPT 144B or RPT 220B Kit	$465.95
RPT 432B Kit	515.95
RPT 144B or RPT 220B factory wired and tested	695.95
RPT 432B factory wired and tested	795.95

WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

vhf engineering
synthesizer II

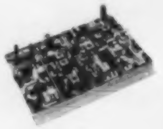
The Synthesizer II is a two meter frequency synthesizer.
Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 KHz to 10 MHz. No additional components are necessary!

Kit	$169.95
Wired and tested	$239.95

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS



RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	59.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T.	same as above – factory wired and tested	114.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T	same as above – factory wired and tested	114.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50
RF28 Kit	10 meter RF front end 10.7 MHz output	12.50
RF50 Kit	6 meter RF front end 10.7 MHz output	12.50
RF144D Kit	2 meter RF front end 10.7 MHz output	17.50
RF220D Kit	220 MHz RF front end 10.7 MHz output	17.50
RF432 Kit	432 MHz RF front end 10.7 MHz output	27.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TRANSMITTERS

TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T.	same as above – factory wired and tested	49.95
TX220B Kit	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T.	same as above – factory wired and tested	49.95
TX432B Kit.	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above - factory wired and tested	59.95
TX150 Kit	300 milliwatt, complete 2 meter transmitter, less crystal and mike	19.95

POWER AMPLIFIERS

PA2501H Kit	2 meter power amp – kit 1 w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95
PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95

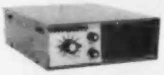
POWER SUPPLIES

PS15C Kit	15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max	9.95
PS3A Kit	12 volt – power supply regulator card with fold back current limiting	8.95
PS3012	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/foldback current limiting and over voltage protection, wired and tested	239.95

REPEATERS

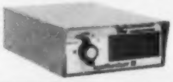
RPT28 Kit	repeater – 10 meter	TBA
RPT28	repeater – 10 meter, wired & tested	TBA
RPT50 Kit	repeater – 6 meter	TBA
RPT50	repeater – 6 meter, wired & tested	TBA
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95
RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
DPLX144	2 meter, 600 KHz spaced duplexer, wired and tuned to frequency	399.95
DPLX220	220 MHz duplexer, wired and tuned to frequency	399.95

TRANSCEIVERS



TRX 144 Kit	case and all components to build 15 watt 10 channel scanning 2 meter transceiver (less mike and crystals)	219.95
TRX 220 Kit	same as above except for 220 MHz	219.95
TRX 432 Kit	same as above except 10 watt and 432MHz	254.95

SYNTHESIZERS



SYN II Kit	2 meter synthesizer, transmit offsets programmable from 100 KHz - 10 MHz, (Mars offsets with optional adapters)	169.95
SYN II	same as above, wired and tested	239.95

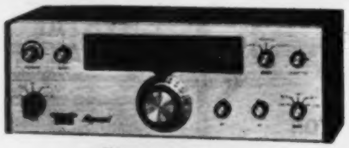
WALKIE TALKIES

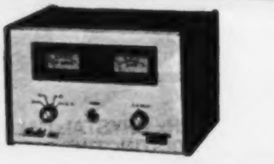
HT 144B Kit.	2 meter, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
NICAD	battery charger	5.95
Rubber Duck	2 meter, with male BNC connector	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/ diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD-3 Kit	UHF version of CD-1 deck, needed for 432 multi-channel operations	12.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority.	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
Microphone	2,000 ohm dynamic mike with P.T.T. and coil cord	9.95

TEN-TEC


ARGONAUT
#509


AMPLIFIER
#405

ARGONAUT, MODEL 509
Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405
Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509	**$329.00**
Linear Amplifier, Model 405	**159.00**
Power Supply, Model 251 (Will power both units)	**79.00**
Power Supply, Model 210 (Will power Argonaut only)	**27.50**

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, preselectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:

Model 240 One-Sixty Converter	**$ 97.00**
Model 244 Digital Readout	**197.00**
Model 245 CW Filter	**$ 25.00**
Model 249 Noise Blanker	**29.00**
Model 252G Power Supply	**99.00**
Model 262G Power Supply/VOX	**129.00**

TEN-TEC

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. **PRICE $67.50**

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. **PRICE $38.50**

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. **PRICE $25.00**

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. **PRICE $15.00**

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortlessly. The iambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

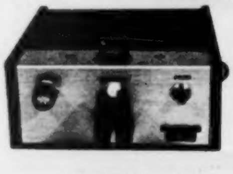
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

PRICE $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms
Power Source: 117VAC, 50-60 Hz, 6-14 VDC
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50A

Nye Viking

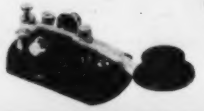
Model 310-001: Standard Key, nickel plated hardware, no switch — $6.65.

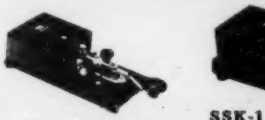
Model 310-003: Standard Key, nickel plated hardware, with switch — $8.25.

Model 320-001: Standard Heavy Duty Key with nickel plated hardware, no switch — $8.20.

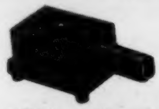
Model 320-003: Same as -001 except with switch — $9.35.

322-001





Code Practice Set with Key — $18.50.



SSK-1: Chrome plated — $29.95; Black Wrinkle Finish — $23.95.

Now You Can Receive The Weak Signals With The ALL NEW AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- **Improves sensitivity and signal-to-noise ratio.**
- **Boosts signals up to 26 db.**
- **For AM or SSB.**
- **Bypasses itself automatically when the transceiver is transmitting.**
- **FET amplifier gives superior cross modulation protection.**
- **Advanced solid-state circuitry.**
- **Simple to install.**
- **Improves immunity to transceiver front-end overload by use of its built-in attenuator.**
- **Provides master power control for station equipment.**

MODEL PT-2

$69.95

For all you hams with little cars ...

We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

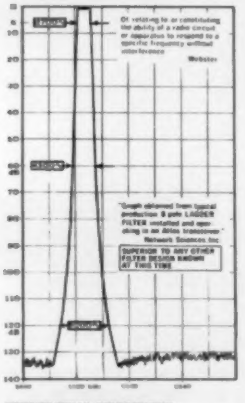
200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.



PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
ACCESSORIES:	
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	59.00
Digital Dial DD-6B	329.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS
RADIO INC.

mounts-leads-accessories

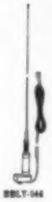
STANDARD GAIN MOBILES

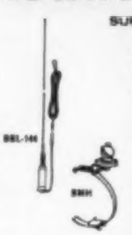
Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $28.75

MODEL BBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $25.95


BBLT-144



HUSTLER "BUCK-BUSTER"

MODEL SF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included). $12.75

SF-2

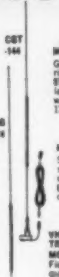
HEAVY DUTY BUMPER MOUNT FITS ANY SHAPE BUMPER
MODEL BMH
New design is rugged for supporting Hustler antenna with standard or Super resonators. Includes Model SSM-2 ball mount and strap from stainless steel. $14.95

SUPER GAIN MOBILES

Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS—TRUNK LIP MOUNT
MODEL HFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259. $21.45

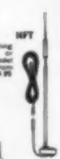


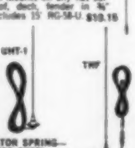
MODEL CGT-144
Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling—complete with 17' MIL SPEC RG-58-U and PL-259. $30.95

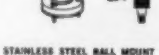
MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts—Length is 85". Mount and cable not included. $26.75

VHF/UHF ANTENNA—ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U. $10.15

VHF/UHF ANTENNA—TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. $15.95

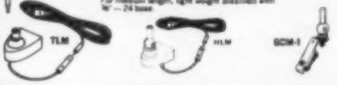

HFT





DELUXE MOBILE MOUNTS

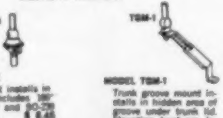
For medium length, light weight antennas with ⅜"—24 base



MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached. $12.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy—no holes—installation. Includes 17' RG-58-U cable and connectors attached. $14.85

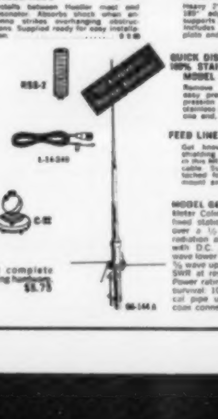
MODEL GCM-1
Rain gutter mount fits all shapes, angles even lowest trim line gutters. Includes 180° swivel ball. $7.50



MODEL HM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors. $ 8.45

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. $7.50

RESONATOR SPRING—STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. .... $ 9.95



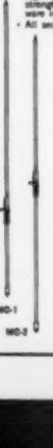
MODEL C-22
Ball mount complete with mounting hardware. $5.75

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cycolac base, steel back-up plate and mounting hardware. $13.50

QUICK DISCONNECT—100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other. $11.75

FEED LINE **MODEL L-14-240**
Get known performance, maximum shielding for minimum noise pick-up in this MIL SPEC 240 length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver. $ 7.95

MODEL GS-144A — Deluxe, Two Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. SO-239 coax connector $52.95



HUSTLER RESONATORS

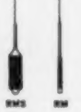
All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

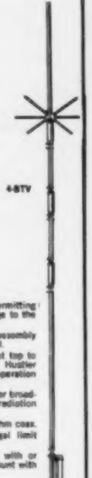
STANDARD HUSTLER RESONATORS—
Power Rating: 400 watts SSB

Model	Band	Price
RM-10	10 meters	$10.75
RM-15	15 meters	$11.75
RM-20	20 meters	$12.75
RM-40	40 meters	$15.95
RM-75	75 meters	$16.95
RM-80	80 meters	$16.95

SUPER HUSTLER RESONATORS—
Power Rating: Legal Limit SSB
Supers have widest band-width

Model	Band	Price
RM-10-S	10 meters	$13.95
RM-15-S	15 meters	$15.95
RM-20-S	20 meters	$18.75
RM-40-S	40 meters	$23.50
RM-75-S	75 meters	$26.95
RM-80-S	80 meters	$26.95




4-BTV

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss—high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5"
MODEL 4-BTV

Weight: 15 lbs.
$79.95

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

For 6 - 10 - 15 - 20 - 40 - 75 - 80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. $15.95

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. $15.95

HUSTLER

SUPER AMP
from DenTron

$499.50

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI sheilding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4 - 811 A's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all at $499.50.

NOW AVAILABLE WITH 572 B^s FOR **$574.50**

DenTron

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50

Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

DenTron

The 80-10 Skymatcher

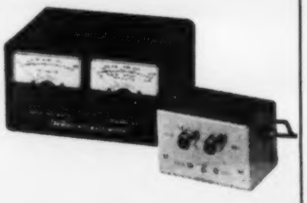
Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

ANTENNA MATCHING
INDUCTANCE
DenTron RADIO
80-10 AT

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

$59.50

Read forward and reflected watts at the same time



Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

DenTron

The Sky Openers

SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

Also 80 m resonator for top mounting on SKYMASTER.

$29.50

SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds.. Handles full legal power limit.

$79.50

EX-1

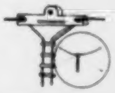
The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50



ALL BAND DOUBLET

This All Band Doublet or inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

DenTron

HAM RADIO / MOBILE COMMUNICATIONS

THOMSON-CSF
NPC
ELECTRONICS

MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13CB4	$41.95
102	$24.95	104R	$49.95
612	$27.95	12/115	$69.95
107	$28.95	108R	$79.95
12CB4	$29.95	108RM	$99.95
		109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous, 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

ALSO! Available as 13 HM 4 with built-in loudspeaker.

	TYPICAL	MAXIMUM
Output Voltage	13.5 ± .5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

NPC
THOMSON-CSF
ELECTRONICS
POWER SUPPLY
REGULATED
ON
OFF
MODEL 12CB4
FOR C B
TRANSCEIVER
115 VAC/13.5 VDC 2.5 AMP REG
MADE IN U.S.A.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

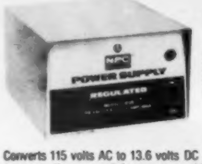
NPC
POWER SUPPLY
SOLID STATE

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 103R



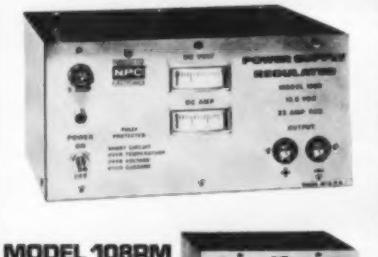
NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MODEL 109R



NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 16 lbs.

MODEL 12V4

ON
MODEL 12V4
POWER SUPPLY

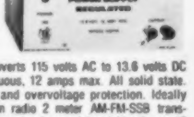
NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM



NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4½" (H) x 7½" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC
POWER SUPPLY
REGULATED

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 5½" (W) x 6½" (D). Shipping Weight: 6 lbs.

MODEL 102

POWER SUPPLY
SOLID STATE

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

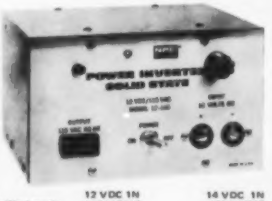
Functions silently in converting 115 volts AC to 12 volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.6 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MARINE & RV

MODEL 12-115



NPC 12-115 Solid State Inverter, 200 W. Parallel Connection for Higher Power up to 350 W.

Converts 12 volts DC to 115 volts AC @ 60 Hz output. 200 watts continuous operation with peak power up to 240 watts. All silicon semiconductors assure high reliabiltiy at excessive ambient temperatures. The output voltage is a square wave. The inverter is not recommended where high transients are not tolerable.

The 12-115 allows you to have AC house current in your boat, car, truck, camper, house trailer, or houseboat. Will operate small household appliances, T.V., hand tools, electric shaver, AC radios, and lights within power rating. Built-in overload protection.

Case: 4½" (H) x 7½" (W) x 5½" (D). Shipping Weight: 7 lbs.

	12 VDC IN		14 VDC IN
Output Voltage (No Load)	115 V RMS		130 V RMS
Output Voltage (Full Load)	100 V RMS		115 V RMS
Frequency (No Load)	58 Hz		66 Hz
Frequency (Full Load)	54 Hz		62 Hz
Power Continuous		200W	
Power Peak		240W	
Parallel Connection		350W	

All Values Are Typical

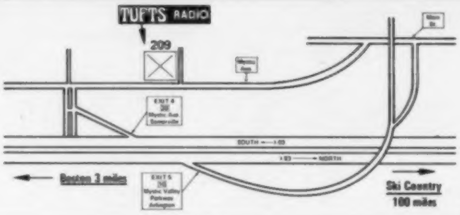
MODEL 612

Model 612 Power Converter

NPC 612 converts 6 volt negative ground or 12 volt positive ground electrical systems to 12 volt negative ground operation. Provides full 3 amp continuous power. The inexpensive solution for installing car radios, stereo and cassette tape players, in vehicles with 6 volt negative ground or 12 volt positive ground systems.

Case: 2⅝" (H) x 3" (W) x 8" (D). Shipping Weight: 1 lb.

NPC
POWER INVERTER
NPC 6/12 INVERTER
MODEL 612
3 AMP MAXIMUM



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Plenty of FREE Parking Space

Right off 93 North – Easy To Get To!

SEE OUR LARGE NEW SHOWROOM!

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CLIPREAMP
IN
OUT
COMPR. LEVEL
B·W

Model 372 – $27.50

model 372 CLIPREAMP

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

- **specifications**

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connections	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 – $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

- **specifications**

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Ampere, 40 to 130 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 3002W and model 3001W

UNIVERSAL HYBRID COUPLER II

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

- **specifications**

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6-1/2" x 7-1/2" x 3"
Shipping Weight	3-1/2 lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connections	Phono

Model 300 2W with *Compreamp* – $125.00

Model 300 1W without *Compreamp* – $85.00

B&W

BARKER & WILLIAMSON, INC.

COMPREAMP
MODEL 359
IN
OUT
COMPR. LEVEL
B·W

Model 359 – $37.50

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the *Compreamp* between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

- **specifications**

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	6-1/2 oz.
Connections	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB. Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

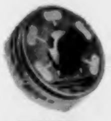
Crosstalk (measured at 30 MHz) is -45 dB between adjacent outlets and -60 dB between alternate outlets.

Models are available for desk, wall, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted; axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.

Model 550A

Model 590



Model 590G

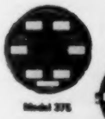
Model 551A

Model 592

Model 595

COAXIAL SWITCH SELECTOR CHART

Model	PRICE	Outputs	Connector Placement	Mounting			Automatic Grounding	Dial Plate	Remarks
				Panel	Wall	Desk			
375	18.95	6	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
550A	14.00	5	Radial	x	x			DP-5	
550A-2	12.50	2	Radial	x	x			DP-2	
551A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
590	17.95	5	Axial	x				DP-5	
590G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
592	16.50	2	Axial	x				DP-2	
595	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.



Model 375

Model 376

Model 550A-2

Poly Pak's EXCLUSIVE BARREL KITS®

Avg. Ship. Wt. 6 ozs.

$1.98 YOUR CHOICE OF ANY KIT

Every kit carries a money back guarantee!

Buy 10 BARREL KITS AND CHOOSE THE 11TH KIT Free

100'S OF BARRELS PURCHASED!

For the first time anywhere, Poly Pak merchandisers introduce a new way in buying the economical way. Raw stock from the "barrel". Remember the "good ole days"? They're back again. The same way merchandisers throughout the United States buy from various factories . . . their over-runs in barrels. Poly Pak has done the same. Therefore you are getting the same type of material as the RE-TESTERS DO!

TEST 'EM YOURSELF 'N SAVE!

BARREL KIT #200
9 DIGIT READOUT MODULES
5 for $1.98 with calculator & driver chips beneath epoxy. How good? Who knows! Cat. No. 1A3515

BARREL KIT #203
CALCULATOR KEYBOARDS
10 for $1.98
It's true! 20-key, 4 function keyboards at ridiculous give-away. Wt. 12 ozs. Cat. No. 1A3524

BARREL KIT #188
400 Parts $1.98
Includes resistors, caps, transformers, rectifiers, diodes, etc. for p.c. work. Preformed, dumped into barrels by factories. 100%. Cat. No. 1A3401

BARREL KIT #186
KEYBOARD CHIPS
10 for $1.98
Truthfully we can't tell 'em, MM5740's, keyboard encoder chips. How good they are we don't know. Cat. No. 1A3414

BARREL KIT #184
¼-WATT METAL FILM
150 for $1.98
100% metal film resistors. Long leads. 1A3413

BARREL KIT #182
JUMBO RED LEDS
15 for $1.98
100% material, user cancellation from factory dumps, 3V 16 mils. For 100's of projects, red lens. Cat. No. 1A3369

BARREL KIT #178
TERMINAL STRIPS
1-lb. $1.98
Bot 5 tons! Factory mixed, but nicely asstd 250 pcs approx. Quite a saving. Cat. No. 1A3096

BARREL KIT #167
ROMS-RAMS-REGISTERS
1-lb. $1.98
with approx count of 80 pcs. You get more. Mostly marked, mostly National. Some 40 pins. 1A3064

BARREL KIT #166
LONG LEAD DISCS
4 ozs. $1.98
No counting makes it so you get 150-pc. kit (approx). All marked, 100%. Cat. No. 1A3089

BARREL KIT #163
MINI TRIM POTS
30 for $1.98 1 oz.
Asst. values 100 to 1 meg 'em. What a buy. Single turn. ¼ W. Wt. 6 oz. Cat. No. 1A3346

BARREL KIT #161
'POP' PLASTIC TRANSISTORS
25 for $1.98
2N3904's with some 2N3906's of 100% material. TO-92. Preformed. Cat. No. 1A3343 1 oz.

BARREL KIT #164
V. REGULATORS
15 for $1.98
LM309KC TO-3 V.R.'s barreled. Bot by the pound. No. 1A3330

BARREL KIT #159
MODULAR SWITCHES
25 for $1.98
Centralab switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat. No. 1A3150

BARREL KIT #157
MOLEX CONNECTORS
100 for $1.98 12 ozs.
Nylon, white cable connectors, asst. factory over-run. NO PICKEE! Mixed in barrels. Cat. No. 1A3224

BARREL KIT #154
CLOCK CHIPS
20 for $1.98
We gathered an assortment of clock chip, alarm, calendar, beepers, who knows, all mixed. Cat. No. 1A3308

BARREL KIT #151
INCANDESCENT
15 for $1.98
Importer sez, "Name your price". Hard to find 7-seg. 5V readouts. How good, asst sizes, we don't know. Can't test 'em. 1A3306

BARREL KIT #149
ROCKER SWITCHES
25 for $1.98 13 ozs.
Barrels 'n barrels, so many, our customers should get the deal. No. 1A3303

BARREL KIT #145
MINI TRANSFORMER
15 for $1.98
Miniature transformer back again. Asst. outputs, interstage and audio. Only 1" sq. Wt. 2 lbs. 1A3294

BARREL KIT #144
RCA PHONO PLUGS
40 for $1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know wut they are . . . 100% material. 1A3293

BARREL KIT #143
75-PC TRANSISTORS
$1.98
100% material, TO-92, factory discontinued lines, pnp's mixed with npns, 2N4400-1-2-3-4. 1A3290

BARREL KIT #140
LAMPS, INDICATORS
20 for $1.98
Precision mini lamp all-metal, panel, with mtg hardware. Lamp maker's overstock. No. 1A3287

BARREL KIT #132
PANEL SWITCHES
30 for $1.98
Did you hear of OAK? Another eqpt maker barrelled all types of rotaries, electric, slides, etc. 1A3269

BARREL KIT #134
CALCULATOR CHIPS
15 for $1.98
National type. Can be MM5738, 38, etc. Untested. Cat. No. 1A3258

BARREL KIT #131
TANTALUM ELECTROS
30 for $1.98
Mixed, marked prime, top grade asst. values, voltages. Cat. No. 1A3255

BARREL KIT #130
CRYSTALS!
12 for $1.98 2 ozs.
Large U.S. maker dumped frequency marked H/6U crystals in barrels. Some worth $5. Precision. Many in 8 mc areas. 1A3250

BARREL KIT #128
MINI DIP ICS
75 for $1.98
Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 703, 567, 555, 558—but who knows? Wt. 1 lb. 1A3245

BARREL KIT #127
AXIAL ELECTROS
40 for $1.98
Asst. capacities and voltages. Cat. No. 1A3227

BARREL KIT #126
UPRIGHT ELECTROS
40 for $1.98
1mf to 300mf in mixture of voltages. 100% marked 'n good. 1A3226

BARREL KIT #119
PRECISION RESISTORS 100% good
100 for $1.98
PREFORMED! Designed for printed circuit work. ¼, ½ w. Marked values, 1 and 2% values. 2 ozs. 1A3205

BARREL KIT #118
MINI SCRS
50 for $1.98
UNBELIEVABLE! TO-92 plastic SCRS in barrels . . . rite from factory. Includes all voltages up thru 200 prs. 1A3135

BARREL KIT #117
OPTICAL FIBERS 2 ozs.
20-MIL 1A3206
200-FT. $1.98
Fiber optics factory bankruptcy purchase! High quality, most-commonly used size (20-mil), CLEAR.

BARREL KIT #115
MOLEX SOCKETS 100% good
200 for $1.98 Cat. No. 1A3144
Calculator maker dump! We got a zillion of 'em. Used for IC sockets, etc.

BARREL KIT #112
MICRO MINI LEDS
40 for $1.98
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. 1A3138

BARREL KIT #109
TERMINAL STRIPS
100 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb Cat. No. 1A3136

BARREL KIT #105
MINI VOLUME CONTROLS
25 for $1.98
1-Million pcs of 100%, 50K mini pots, ceramic case, long shaft. Eqpt maker unloads. 1A3058

BARREL KIT #104
SLIDE VOLUME CONTROLS
10 for $1.98
Cat. No. 1A3057

BARREL KIT #101
RESISTOR SPECIAL
200 for $1.98
Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 8 oz. 100% good. 1A3054

BARREL KIT #99
PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat. No. 1A3052

BARREL KIT #93
HALF WATTERS
200 for $1.98
Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. 1A3046 Untested

BARREL KIT #92
3 AMP EPOXY RECTIFIERS
100 for $1.98
Cosmetic rejects, electrically fine business! You check 'em; it's not for us. Asst. voltages. Untested [illegible]

BARREL #91
SILVER MICAS
100 for $1.98
Axial, red case, variety of physical sizes & values Cat. No. 1A3016

BARREL KIT #89
LITRONICS LED READOUTS
10 for $1.98
747's, 727's, singles, triples, etc. .33 to 0.6. Bot from factory, all mixed; have fun! No. 1A2861

BARREL KIT #87
NATIONAL IC BONANZA
100 for $1.98
Types 8000, 7400 series, DTLs, ROMs, registers, clock & calc. chips, linears, etc. Cat. No. 1A2860 Untested.

BARREL KIT #86
HOBBY LEDS
40 for $1.98 Untested.
Wow! A Litronics dump of all kinds of mixed discrete LEDS, shapes, colors, good, poor, etc. 1A2859

BARREL KIT #83
15 for $1.98
LM-340T VOLT REG
Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat. 1A2635

BARREL KIT #81
SUBMINI RESISTORS
200 for $1.98
PC, upright type, color coded, ⅛ watt. Asst values. Came to us in a barrel. Cat. No. 1A2746 100% good

BARREL KIT #76
1-WATT ZENERS
100 for $1.98
Factory same as 400-mw's. Never-to-see-again offer. 6, 8, 10, 12, 15V. under glass. Double plug. Cat. No. 1A2741 Untested.

BARREL KIT #75
400MW ZENERS
150 for $1.98
Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V. You test. Hermetically sealed glass pak. Double plug. Cat. No. 1A2740

BARREL KIT #73
TRANSISTOR ELECTROS
50 for $1.98
We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 1A2747

BARREL KIT #71
CAPACITOR SPECIAL
100 pcs. $1.98
micas, moldeds, plastics, ceramics, discs, etc. Nifty 100% good Cat. No. 1A2739

BARREL KIT #68
2 WATTERS
100 for $1.98 100% good.
All marked. Cat. No. 1A2738

BARREL KIT #65
MIXED READOUTS
10 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. Cat. No. 1A2733 Untested.

BARREL KIT #61
POLYSTYRENE CAPS
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat. No. 1A2729

BARREL KIT #58
SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, spdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat. No. 1A2728 100% good

BARREL KIT #54
POWERS! POWERS!
100 for $1.98
Large distributor cleaned house. Barrels of power resistors 3 to 7 watts. Cat. No. 1A2724

BARREL KIT #54
8 DIGIT READOUTS
10 for $1.98
Bargain of a lifetime! All we got was 1 barrel — the "blisdor digit" types. Multiplexed. Cat. No. 1A2722

BARREL KIT #46
G.E. 3.5 WATT AMPLIFIERS
25 for $1.98
Hobby type, factory fallouts. 1A2624 Untested

BARREL KIT #40
PNP HIGH-POWER TRANSISTORS
20 for $1.98
Popular germanium TO-3 case 1A2618 100% good

BARREL KIT #39
2N3055 HOBBY TRANSISTORS
15 for $1.98
Fallouts of the famous 2N3055. 1A2617 100%

BARREL KIT #37
1 AMP "BULLETT" RECTIFIERS Untested
100 for $1.98
Famous style, asstd. voltages, silicon, axial includes all types of voltages to 1KV. Cat. No. 1A2615

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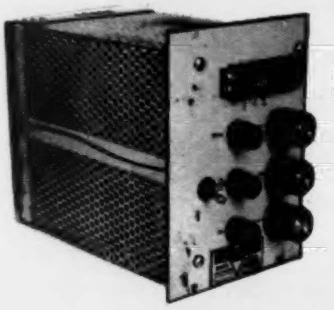
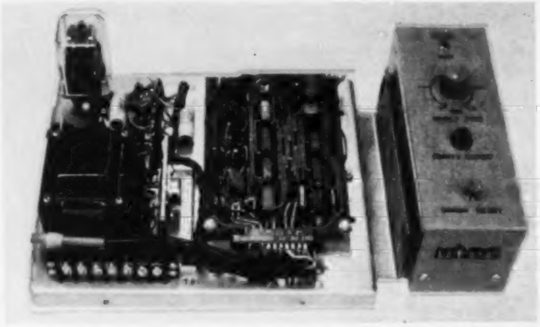
A well designed transistorized regulated power supply with many uses. Each voltage adjustable by a pot. Each voltage fused. 115 volts AC 60 cycle input. Output (minus) 12 volts at 1/3 Amp, 12 volts (plus) at 3 Amps, 6 volts at 1 Amp . . . three output voltages. Many uses . . . as battery charger, op amp, 5 volt logic supply, operate your car radio or tape player, CB set, in the house, etc. A commercially built regulated supply for far less the price of a kit. Shipping wgt. 10 lb. #SP-152-L $17.50





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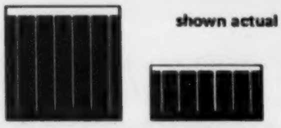

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Kit shipped with 2 MHZ crystals for existing 500NS memory. Easily modified for faster RAM chips when the prices come down.

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Kit includes Zilog Manual and all parts.

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You requested it! Our first DC operated clock kit. Professionally engineered from scratch to be a DC operated clock. Not a makeshift kluge as sold by others. Features: Bowmar 4 digit .5 inch LED array, Mostek 50252 super clock chip, on board precision time base, 12 or 24 hour real time format, perfect for cars, boats, vans, etc. Kit contains PC Board and all other parts needed (except case). 50,000 satisfied clock kit customers cannot be wrong!

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KIT INCLUDES CRYSTAL, DIVIDER IC, PC BOARD PLUS ALL OTHER NECESSARY PARTS & SPECS

50HZ CRYSTAL TIME BASE KIT – $6.95

All the features of our 60HZ kit but has 50HZ output. For use with clock chips like the 50252 that require 50HZ to give 24 hour time format.

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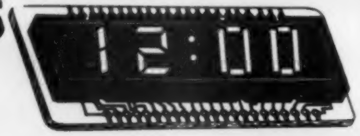

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No. TR1602B. 40 pin DIP
This is a very powerful and popular part.
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¼ W 5% and 10% PC leads. A good mix of values. 200/$2.

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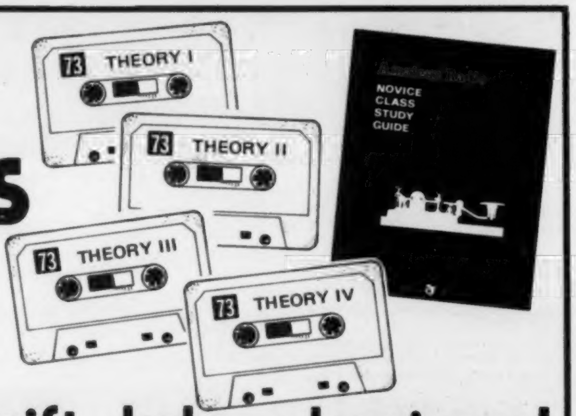

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6 Digit LED Clock Kit - 12/24 hr.

$9.95 ea. QTY. 12 OR MORE — $10.95 ea. QTY. 6-11 — $11.95 ea. QTY. 1-5

KIT INCLUDES
- INSTRUCTIONS
- QUALITY COMPONENTS
- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

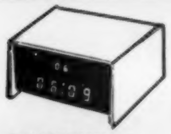
6-LED Readouts(FND-359 Red, com. cathode)
1-MM5314 Clock Chip (24 pin)
13-Transistors
3-Switches
6-Capacitors
5-Diodes
9-Resistors
24-Molex pins for IC socket

LARGE .4" DIGITS!
ORDER KIT #850-4
AN INCREDIBLE VALUE!

"Kit #850-4 will furnish a complete set of clock components as listed. The only additional items required are a 7-12 VAC transformer, a circuit board and a cabinet, if desired."

Printed Circuit Board for kit # 850-4 (etched & drilled fiberglass)	$2.95
Mini-Brite Red LED's (for colon in clock display) pkg. of 5	1.00
Molded Plug Transformer 115/10 VAC (with cord)	2.50

NOTE: Entire Clock may be assembled on one PC Board or Board may be cut to remote display. Kit # 850-4 will fit Plexiglas Cabinet II.



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Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

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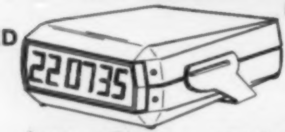
MOBILE LED CLOCK

12 OR 24-HOUR OPERATION

12 VOLT AC or DC POWERED FOR FIXED OR MOBILE OPERATION.

SIX LARGE .4" DIGITS!

KIT OR ASSEMBLED — MODEL 2001



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Approx. Size:
1¾"H x 4"W x 4½"D

BATTERY BACK-UP FOR POWER FAILURE OR TRANSPORTING FROM HOUSE TO CAR, ETC.

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM.
- SET TIME FROM FRONT VIA HIDDEN SWITCHES
- 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY (Use When Key Off in Car, Etc.)
- TOP QUALITY PC BOARDS & COMPONENTS - EXCELLENT INSTRUCTIONS
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT (Less 9V. Battery) 29.95 EA. — 3 OR MORE $27.95 EA. — 115 VAC Power Pack #AC-1 $2.50 EA.

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WIRED FOR 12 HR. OP. IF NOT SPECIFIED OTHERWISE

JUMBO RED LED's 12/$1.00 50/$3.95

6 Digit-LED Clock-Calendar-Alarm Kit

This is a complete, top of the line, Kit for the person that wants the best. Some of the many features and options are: 12/24 time, 28-30-31 day calendar, alternates time (8 sec) and date (2 sec) or can display time only and date on demand, 24 hr alarm - 10 minute snooze, alarm set indicator, 50/60 HZ. line operation or use with Xtal time base (#TB-1), built in OSC for battery back-up / AC failure, Aux. timer, CHOICE OF DIGITS.

Kit #7001B	6 - .4" Digits	$39.95
Kit #7001C	4 - .6" Digits & 2-." [Seconds]	$42.95
Kit #7001X	6 - .6" Digits	$45.95

Kits are complete (less cabinet) including PC boards, power supply, IC socket, 9 switches, 16 transistors and all parts required for above features and options **[All #7001 Kits Will Fit Cabinet I Above]**

60 HZ.
XTAL TIME BASE KIT

Will enable Digital Clock or Clock-Cal. Kits to operate from 12VDC. Uses MM5369 and 3.58MHZ. XTAL. Req. 5-15VDC/2.5 MA. 1"x2" PC Board. Easy 3 wire hookup Accuracy: +- 2 PPM

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JUMBO DIGIT CLOCK KIT

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC, 12/24 Hr. time, 50/60 HZ., Plug-Transformer, Line Cord, Switches, and all Parts.
[Ideal Fit in Cabinet II]
Kit #5314-5. $19.95 ea. 2/$38.

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Convert small digit LED clock to large .5" displays. Kit includes 6-.5" LED's, Multiplex PC Board & easy hook-up info.
Kit #JD-1CC For common Cathode
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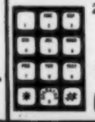

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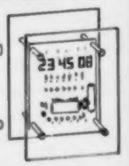

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TS-820 Specifications

FREQUENCY RANGE: 1.8-29.7 MHz (160 - 10 meters)
MODES: USB, LSB, CW, FSK
INPUT POWER: 200W PEP on SSB
160 W DC on CW
100 W DC on FSK
ANTENNA IMPEDANCE: 50-75 ohms, unbalanced
CARRIER SUPPRESSION: Better than 40 dB
SIDEBAND SUPPRESSION: Better than 50 dB
SPURIOUS RADIATION: Greater than -60 dB (Harmonics more than -40 dB)
RECEIVER SENSITIVITY: Better than 0.25uV
RECEIVER SELECTIVITY:
SSB 2.4 kHz (-6 dB)
4.4 kHz (-60 dB)
CW* 0.5 kHz (-6 dB)
1.8 kHz (-60 dB)
*(with optional CW filter installed)
IMAGE RATIO: 160-15 meters: Better than 60 dB
10 meters: Better than 50 dB
IF REJECTION: Better than 80 dB
POWER REQUIREMENTS: 120/220 VAC, 50/60 Hz, 13.8 VDC (with optional DS-1A DC-DC converter)
POWER CONSUMPTION: Transmit: 280 Watts
Receive: 26 Watts (heaters off)
DIMENSIONS: 13-1/8" W x 6" H x 13-3/16" D
WEIGHT: 35.2 lbs (16 kg)

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The TS-520 operates SSB and CW on 80 through 10 meters and features built-in AC and 12VDC power supply.

TS-520 Specifications

MODES: USB, LSB, CW
POWER: 200 watts PEP input on SSB, 160 watts DC input on CW
ANTENNA IMPEDANCE: 50-75 Ohms, unbalanced
CARRIER SUPPRESSION: Better than -45 dB
UNWANTED SIDEBAND SUPPRESSION: Better than -40 dB
HARMONIC RADIATION: Better than -40 dB
AF RESPONSE: 400 to 2600 Hz (-6 dB)
AUDIO INPUT SENSITIVITY: 0.25μV for 10 dB (S+N)/N
SELECTIVITY: SSB 2.4 kHz (-6 dB), 4.4 kHz (-60 dB), CW 0.5 kHz (-6 dB), 1.5 kHz (-60 dB) (with accessory filter)
FREQUENCY STABILITY: 100 Hz per 30 minutes after warmup
IMAGE RATIO: Better than 50 dB
IF REJECTION: Better than 50 dB
TUBE & SEMICONDUCTOR COMPLEMENT: 3 tubes (2 x 6146B, 12BY7A), 1 IC, 18 FET, 44 transistors, 84 diodes
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WEIGHT: 35.2 lbs.

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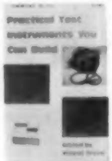

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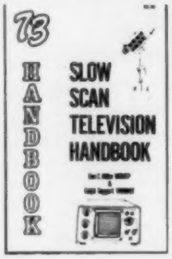

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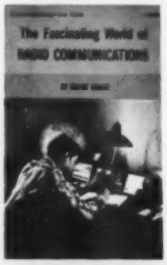

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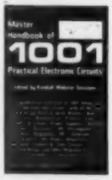

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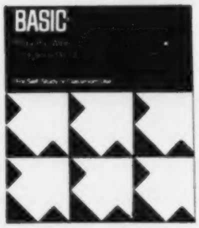

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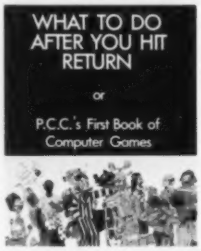
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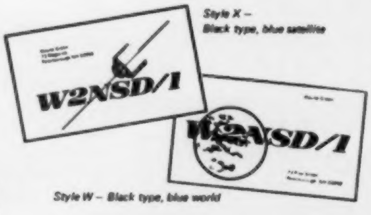

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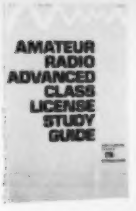

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number is recovered, it can be identified in minutes through the police computer system. Ham and CB callsigns are, of course, not put into the computer, thus making on the spot identification virtually impossible.

3. Fill out a theft report. Depending on how the local police operate, either they will come to you or you'll have to make a trip to the station.
4. If possible, take a couple of photograghs showing forced entry point.
5. After filling out the theft report, obtain two copies, one for yourself and a second for the friendly local insurance company.
6. Call your friendly local insurance agent and begin the fun known as making a claim.
7. Go fix yourself a drink.
8. Relax!

The problem of mobile gear ripoffs is going to get much worse. Here's hoping that you don't become another statistic.

Steve Zawicki WA1UUK

Reprinted from Key Klix and Splatter, *the official newsletter of the Montachusetts Amateur Radio Club.*

Tragedy On Mt. Wilson

Late this evening it was dramatically proven that preparedness and training in the art of locating a hidden transmitter can pay off. The Mt. Wilson Repeater Association has been holding bi-weekly T-Hunts using the input channel to the WR6ABE repeater and doing so while the repeater is in full operation. I cannot think of any more adverse conditions under which to try and T-Hunt anything.

About 5:45 on the evening of Saturday, September 4, a rather raucous noise appeared on the input of WR6ABE and stayed there. Later in the same evening a rather foul-mouthed character appeared on the system claiming responsibility for this sickening act against the Southern California amateur community.

A check of the input by various stations around the city gave an approximate location for Mr. Foul Mouth, but didn't reveal the source of the raucous buzzsaw noise. Not being able to hear the interference from the lowlands even on the rather supersensitive L-Per DF receivers connected to base station antennas, the T-Hunt crew decided to play a hunch and go check the area of the site itself.

By about 3 am, the T-Hunters were sure that their hunch was correct, but the darkness and rather rugged terrain made any further attempt to get an exact location a dangerous job. Around 4 am the T-Hunters came down off Mt. Wilson and arranged to meet later in the day.

Later that afternoon, September 5, again the T-Hunters headed back up Angeles Crest Highway to the area of the WR6ABE site and brought with them not only DF equipment but metal locaters as well. It took another few hours, but the winner and champion of this T-Hunt turned out to be the ham who located the jamming device about a quarter of a mile from the repeater.

Bill Pasternak WA6ITF
Panorama City CA

By the time you read this, WR6ABE will be silent. Owner Burt Weiner K6OOK decided in late October to shut his Mt. Wilson machine down for 60 days, rather than put up with the jamming, obscenity and varied shenanigans of a handful of users. Some users reportedly have threatened to sue on grounds it and all repeaters are not the property of the owner but rather, by virtue of the service they perform, have become a public utility. One user is trying to drum up support for a separate suit on the grounds he had to buy crystals to use the repeater and the shutdown would make them useless. He claims fraud and is demanding that the system stay on the air to protect his investment (see Briefs). — Ed.

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud *in exchange for a spot on your ham or computer club newsletter mailing list. Deal?*

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by
J. H. Nelson

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	3	3	3	3	3	7	7A	14	14
ARGENTINA	7	7	7	7	7	7	14	14	14	14	14A	14
AUSTRALIA	14	7B	7B	3B	7	7	3B	7	14	14	14	14
CANAL ZONE	7	7	7	7	7	7	7	14	14	14A	14	14
ENGLAND	3A	3	3	3	3	3	7	14	14	14	7	7
HAWAII	14	7B	7	3	3	3	3	3	7	14	14A	14
INDIA	3	3	3B	3B	3B	3B	7	14	7B	7B	3B	3
JAPAN	14	7B	7B	3	3	3	3	3	3B	3B	7	7
MEXICO	14	7	7	7	7	7	7	14	14	14	14A	14
PHILIPPINES	14B	7B	7B	3B	3B	3	3	7	7	7B	3B	7A
PUERTO RICO	7	3	3	3	3	3	7	14	14	14	14	14
SOUTH AFRICA	7	7	3	3A	3	7	14	14	14A	14	14	14
U.S.S.R.	3	3	3	3	3	3B	7A	14	7A	7B	3B	3
WEST COAST	14	7	7	3	7	7	3	7	14	14	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	7	7	7	7	7	7B	14	14	14	14	14A
AUSTRALIA	14	14	7B	7B	7	7	3B	3B	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	14	14A	14A	14
ENGLAND	3	3	3	3	3	3	3	7	14	14	7B	7
HAWAII	14	7B	7	3	3	3	3	3	7	14	14	14
INDIA	3	7	3B	3B	3B	3B	3	7	7A	7	3B	3B
JAPAN	14	7B	7B	3	3	3	3	3	3	3B	7	14
MEXICO	7	7	3	3	3	3	3	7	14	14	14	14
PHILIPPINES	14	7B	7B	3B	3B	3	3	3	7	7	3B	7A
PUERTO RICO	14	7	7	7	7	3	7	14	14	14A	14	14
SOUTH AFRICA	7A	7	3	3	3	3	7B	14	14	14A	14	14
U.S.S.R.	3	3	3	3	3	3B	3B	7A	7A	7B	3B	3B

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	14	7	7	7	7	7	3B	7B	14	14	14	14
AUSTRALIA	14	14	14B	7B	7	3B	3B	3B	7	7A	14	14
CANAL ZONE	14	7	7	3	7	7	3	7	14	14A	14A	14
ENGLAND	3B	3	3	3	3	3	3	7B	14	14	7B	7B
HAWAII	14	14	7	7	3	3	3	3	7	14	14A	14A
INDIA	3B	14	3B	3B	3B	3B	3B	3B	7	7	3B	3B
JAPAN	14	14	7B	3	3	3	3	3	3	3	7A	14
MEXICO	14	7	3	3	3	3	3	7	14	14	14	14
PHILIPPINES	14	14	7B	3B	3B	3	3	3	7	7	7B	14
PUERTO RICO	14	7	7	3	3	3	3	7	14	14	14A	14
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U.S.S.R.	3	3	3	3	3	3B	3B	7A	7A	7	3B	3B
EAST COAST	14	7	7	3	7	7	3	7	14	14	14A	14

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed

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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1 D New Year's Day
2 D	3 U	4 U	5 D	6 U	7 N	8 N
9 N	10 U	11 N	12 N	13 N	14 U	15 U
16 U	17 N	18 N	19 N	20 N	21 N	22 U
23 N 30 N	24 N 31 N	25 N	26 N	27 N	28 U	29 U

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